Peroxyacetyl Nitrate In the Calgary Atmosphere

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PEROXYACETYL NITRATE IN THE CALGARY ATMOSPHERE

FINAL REPORT

RESEARCH MANAGEMENT DIVISION
Alberta Environment

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PEROXYACETYL NITRATE IN THE CALGARY ATMOSPHERE

FINAL REPORT

by

ERIC PEAKE

Kananaskis Centre for Environmental Research
The University of Calgary

for

RESEARCH MANAGEMENT DIVISION
Alberta Environment

RMD 83/24

August 1983

This report is made available as a public service. The Department of Environment neither approves nor disagrees with the conclusions expressed herein, which are the responsibility of the authors.

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ABSTRACT

Nitrogen oxides (NO_x) are major air pollutants in the ambient atmosphere of Calgary which lead to the formation of such secondary pollutants as peroxyacetyl nitrate (PAN), nitric acid, particulate nitrate, and ozone. In high concentrations, these constituents of photochemical smog can produce adverse health, ecological, and environmental effects. The highest PAN concentration recorded over an eight-month period in downtown Calgary was 6.0 ppb, far below the peak of 65 ppb recorded in Los Angeles, California. The mean daily maximum of 0.6 ppb PAN was similar to that of other North American cities, exclusive of California. Maximum daily PAN and ozone concentrations were reached simultaneously each day, usually between 1200 and 1300 h. Low intensity and duration of solar radiation restricted PAN formation in the winter months, whereas the lack of primary pollutants limited formation in the summer. Mean PAN concentrations in the Kananaskis Valley, 70 km west of Calgary, were low, about 0.1 ppb. Infrequent high values of up to 2.3 ppb were associated with forest fire smoke, indicating that PAN has natural as well as anthropogenic sources. Particulate nitrate and nitric acid concentrations in Calgary were low compared with other North American cities, but during occasional pollution episodes, high concentrations, up to 29 ug/m^3 nitrate and 41 ug/m^3 sulphate, were found. Peroxyacetyl nitrate:nitric acid:nitrate ratios indicate that PAN is the major product of NO_x reactions in the atmosphere, and that PAN may play a major role in the long-range transport of acid forming pollutants. Present concentrations of PAN in Calgary are not likely to have major environmental or human health effects, except possibly on highly sensitive individuals.

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1. INTRODUCTION

Air pollution research in North America has, for the past several years, focussed on emissions of acid gases and their contribution to acid rain. This is especially true of the eastern United States and Canada where the sources and magnitude of sulphur dioxide and nitrogen oxide emissions and their long-range transport have been the centre of attention.

In western Canada, studies have been made of the chemistry and environmental effects of sulphur dioxide emissions from natural gas processing plants (Bottenheim and Strausz 1978; Legge et al. 1977, 1981; Legge 1980) and from the processing of the Athabasca oil sands (Bottenheim and Strausz 1979). Concern has also been expressed about the effects on the environment of nitrogen oxide emissions from both industry and urban sources (Legge et al. 1980).

There is a fundamental difference in the perspective of researchers in eastern and western Canada. In eastern Canada, solutions are being sought to existing air pollution problems, whereas in western Canada we are seeking to predict the future effects of expanding industry and increasing population.

For the past decade, Alberta has undergone the highest rate of economic growth of any Canadian province. As a consequence, the major cities of Calgary and Edmonton have undergone a rapid increase in population. Each is expected to double its population by the year 2000. Despite advances in pollution control technologies, increased emission of pollutants, such as nitrogen oxides and hydrocarbons from industrial and transportation sources, are to be expected. Already concentrations of nitrogen oxides in Alberta's cities are amongst the highest in Canada during winter months (Alberta Environment, Air Monitoring Annual Reports, 1977, 1978, 1979, 1980). In November, December, January, and February, Calgary and Edmonton have higher nitrogen oxide concentrations than Toronto and Montreal. Calgary had the highest mean nitrogen oxide concentrations for each

of 14 of the 18 winter months between January 1977 and February 1981 and the second highest mean for two of the remaining four months. A maximum nitrogen oxide one-hour average concentration of 0.52 ppm was recorded on 1981 January 27 in Calgary.

Public awareness and concern about air pollution in Alberta is increasing and there is a need for atmospheric research to predict future concentrations of pollutants. Predicting the concentrations of primary and secondary pollutants in the urban atmosphere of Alberta's cities is, however, a difficult task. These concentrations are influenced by the rate of emission of pollutants, by meteorological factors such as mixing height and ventilation rate, as well as by the complex atmospheric chemistry. The experience of atmospheric and environmental chemists obtained in the warmer, more humid climates of eastern Canada and much of the United States may not be directly applicable to Alberta, with its cool, dry, continental climate. Temperature, intensity and duration of solar radiation, and humidity are known to influence the rates of formation and decomposition of secondary atmospheric pollutants such as peroxyacetyl nitrate, ozone, nitric acid, and particulate nitrate.

This report focusses on (1) measurements of PAN in the Calgary atmosphere; the relationships between PAN, ozone, and major primary pollutants; and a comparison of the concentration of PAN and ozone in Alberta with those of other regions; (2) the concentration of PAN in the rural atmosphere and its role in the long-range transport of air pollutants; and (3) the occurrence of nitric acid (HNO_3) and particulate nitrate (NO_3^-) and sulphate in the atmosphere.

The health, ecological, and environmental effects of each form of nitrate (PAN, HNO_3, and NO_3^-) are different. Consequently, it is important to quantitatively determine the environmental distribution of these secondary pollutants generated from oxides of nitrogen and to understand what environmental conditions affect the relative concentrations (Spicer 1983).

Peroxyacetyl nitrate (PAN) and ozone are two important secondary photochemical air pollutants found in the urban atmosphere

(Stephens 1969; National Research Council 1977). Of the two, PAN is the more useful indicator of photochemical reactions in polluted air because, unlike ozone, it appears to have no large natural source (Nieboer and van Ham 1976; Penkett et al. 1977; Coffey and Stasiuk 1975; Sticksel 1975). Both are strong oxidants which are phytotoxic in high concentrations and can affect human health (Taylor 1969; Taylor and MacLean 1970; National Research Council 1977). PAN is a strong eye irritant and has also been cited as a possible etiological agent in the high incidence of skin cancer observed in tropical regions as compared to temperate ones (Stephens et al. 1960; Mudd 1975; Lovelock 1977).

Previous studies of PAN have related its occurrence to primary pollutants such as nitrogen oxides and hydrocarbons (Pitts 1969; Demerjian et al. 1974; Hecht et al. 1974). The formation of PAN in the polluted atmosphere is believed to be initiated by the reaction of hydroxyl radicals with olefins or aldehydes to form peroxyacyl radicals. These radicals in turn react with nitrogen oxides to form peroxyacyl nitrates, peroxyacetyl nitrate, and lesser amounts of peroxypropionyl nitrate (Stephens 1969; Hecht et al. 1974; Lonneman et al. 1976). The concentration of PAN in the urban atmosphere is influenced not only by solar radiation but also by the magnitude of primary pollutant emissions and meteorological parameters such as temperature, mixing volumes, and ventilation rates.

Ozone measurements for Alberta cities and computer modelling of photochemical air pollution under Alberta climatic conditions have been reported previously (Bottenheim et al. 1977; Bottenheim and Strausz 1979; Environment Canada 1970 to 1981). Although theoretical calculations are available, no field observations have been made so far of PAN concentrations in the Alberta atmosphere to validate the existing models (Sandhu 1975). In general, information of PAN concentrations for other Canadian cities and rural areas is lacking. To our knowledge, the only other studies presently under way are in Toronto (Bottenheim, Atmospheric Environment Service,

Downsview, Ontario; private communication), and in Simcoe, Ontario (Corkum et al. 1982).

An important factor in PAN and ozone formation is the effect of climate. Calgary is in the northern cool temperate zone. It is located at a latitude of 51°N, an elevation of 1050 m, 650 km from the Pacific Ocean and 100 km east of the Continental Divide created by the Rocky Mountains. Mean daily temperature ranges from 10.9°C in July to -10.6°C in January. Average mixing heights are about 2100 m in summer and 360 m in the winter. Mixing heights are often much less than the average and vary greatly because Calgary is subject to temperature inversions and to chinook phenomena.

Measurements of PAN have been made in European cities situated at similar northern latitudes but PAN concentrations have not been reported for cities with the cold, dry, continental climate of Alberta (Nieboer et al. 1976). The cities of Calgary and Edmonton, separated by 300 km and with no other major city within 650 km, can be considered isolated area sources of pollutants. This provides an opportunity to study PAN formation and degradation under cold, dry, climatic conditions.

Nitric oxide produced by the combustion of fossil fuels is oxidized to NO_2 in the atmosphere, and both NO and NO_2 are removed from the atmosphere by a series of chemical and physical processes. The two major pathways appear to be the conversion of NO_x to PAN, and the conversion of NO_2 to nitric acid and nitrate (Grosjean 1983), contributing to acid precipitation. Few studies have been carried out which simultaneously measure NO_x, PAN, nitric acid and particulate nitrate whereby the relative importance of these two pathways can be assessed. None of these studies has been carried out under Alberta climatic conditions.

2. OBJECTIVES

In 1980, a research program was initiated by the Alberta Department of the Environment to understand, predict, and ultimately control photochemical air pollution. Some objectives of this program are:

1. to measure the present rural and urban concentrations of peroxyacetyl nitrate, nitric acid, and particulate nitrate;
2. to establish the relationship among PAN, ozone, and major primary pollutants such as nitrogen oxides, hydrocarbons, and carbon monoxide under Alberta climatic conditions;
3. to compare PAN and ozone concentrations in Alberta with those of other regions; and
4. to identify the role of PAN in the long-range transport of air pollutants.

3. MATERIALS AND METHODS

3.1 ANALYSIS OF PAN

3.1.1 Synthesis of PAN Standards

A series of PAN standards with concentrations of 0.1 ppb to 20 ppb PAN in dry air were generated to calibrate the gas chromatograph electron capture detectors. The generation of these standards presented a number of problems. Peroxyacetyl nitrate is highly reactive in the vapor form and explosive as a liquid. Great care is required during PAN synthesis and the standards, once prepared, degrade rapidly.

At least five reactions have been used to synthesize PAN:

1. the reaction of nitrogen dioxide, acetaldehyde, and oxygen in the presence of chlorine under ultraviolet radiation (Gay et al. 1976);
2. the photolysis of a symmetrical olefin with nitrogen dioxide in dry air;
3. the photolysis of biacetyl and nitrogen dioxide in the presence of oxygen (Kacmarek et al. 1978);
4. the reaction of peracetic acid with sodium nitrate in pentane (Kravetz et al. 1980); and
5. the photolysis of ethyl nitrite vapor in an oxygen atmosphere (Stephens et al. 1965).

The latter method is the most convenient for production of PAN in concentrations of 1000 ppm or more and was chosen for the routine preparation of PAN during this study. (The reaction of acetaldehyde with nitrogen dioxide was also used but only very small quantities of PAN were produced.) Stephens, who pioneered PAN research, synthesized liquid PAN on a large scale with a reactor consisting of two glass tubes, 5 feet (1.5 m) long by 6 inches (15 cm) in diameter, surrounded by 12 ultraviolet fluorescent lights. Oxygen containing 360 ppm ethyl nitrite flowed through the reactor

at the rate of 7 litres per minute. For the present investigation, it was found unnecessary to synthesize more than a few microlitres of PAN, thus minimizing any explosion hazard. Consequently, a much smaller system was used.

3.1.1.1 Preparation of ethyl nitrite. Ethyl nitrite is no longer commercially available; therefore, the first step in PAN synthesis was the preparation of ethyl nitrite:

$$C_2H_5OH + H_2SO_4 \longrightarrow C_2H_5OSO_2OH + H_2O$$

$$C_2H_5OSO_2OH + NaNO_2 \longrightarrow C_2H_5ONO + NaHSO_4$$

Ethyl nitrite was synthesized by the addition of 5.5 mL of cooled sulphuric acid to 5.7 mL of cooled ethanol in a 50 mL erlenmeyer flask immersed in an ice bath. The flask was fitted with a one-hole stopper and connected with a teflon tube to a U-shaped glass trap cooled in a dry ice-acetone bath. Upon addition of 6.9 g of sodium nitrite to the erlenmeyer flask, ethyl nitrite vapor passed through the tube and was retained by the trap. Ethylnitrate has a boiling point of 17°C. Once the reaction was complete, the teflon stopcocks on the trap were closed and the trapped ethyl nitrite was stored at 0°C until used in the synthesis of PAN.

3.1.1.2 Preparation of PAN. A simple, inexpensive system was devised for the preparation of the small quantity of PAN required in the calibration of the gas chromatographs. PAN was synthesized in a 2 L teflon bag by the photolysis of ethyl nitrite in an oxygen atmosphere:

$$C_2H_5ONO + 2O_2 \longrightarrow CH_3\overset{\overset{\displaystyle O}{\|}}{C}OONO_2 + H_2O$$

The trap was warmed (with both stopcocks open) to produce ethyl nitrite vapor, 0.25 mL of which was injected into the teflon bag containing oxygen. The bag was irradiated with a 20 watt "mineral light" from which the filter had been removed to allow passage of all wavelengths of ultraviolet light. Injections of ethyl nitrite vapor were repeated every 15 minutes over a three-hour period. Peroxyacetyl nitrate was transferred into a glass trap cooled in a dry ice-acetone bath by gently squeezing the bag, forcing the PAN vapor through a teflon tube into the trap. The PAN was then transferred into an infrared gas cell by evacuating the cell and connecting it to the trap which was gently warmed to room temperature. From the infrared spectrum the concentration of PAN in the cell was calculated using an absorptivity of 13.9×10^4 $ppm^{-1}m^{-1}$ at 8.60 microns (Figure 1). This band is one of the more intense in the spectrum of PAN and is free from interferences from PAN decomposition products (Adamson and Gunthard 1980). Standards for the calibration of the gas chromatograph were made by diluting PAN vapor (0.005 to 0.5 mL) from the infrared cell into a measured volume of air in a 50 L teflon bag to give PAN concentrations of 0.1 to 20 ppb.

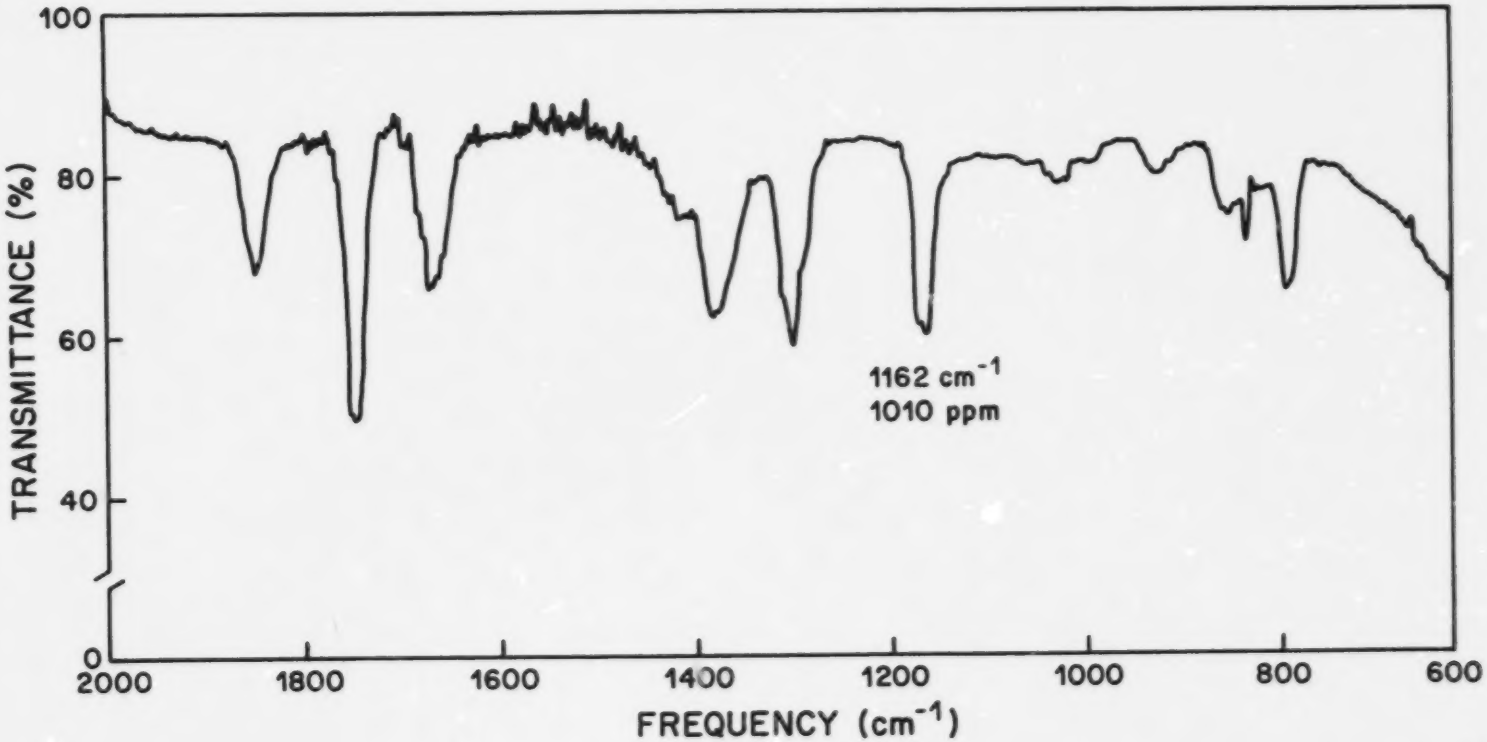

Figure 1. Infrared spectrum of PAN produced by the photolysis of ethyl nitrate in oxygen.

3.1.2 Gas Chromatography

Published conditions for the measurement of PAN in the ambient atmosphere by gas chromatography vary greatly. During this investigation, numerous variables were tested in order to optimize gas chromatographic sensitivity. These variables included several types of liquid phases and concentrations, different column lengths and diameters, two types of carrier gases, various carrier gas flow rates and purge gas flow rates, and several detector and oven temperatures. Both instruments were equipped with nickel 63 electron capture detectors. The Tracor gas chromatograph gave the best performance with the following parameters:

1. 1 m by 1.5 mm glass column packed with 5% Carbowax 600 coated on 60/80 mesh Chromosorb W;
2. nitrogen carrier gas with a flow rate of 50 mL per minute at 80 pounds per square inch;
3. no purge gas; and
4. oven temperature 33°C and detector temperature 80°C with pulse width optimized.

A sample size of 5 mL was used for both calibration standards and ambient air samples. Use of nitrogen, rather than argon-methane, as a carrier gas greatly increased the sensitivity of the electron capture detector but reduced the linear range. Lack of linearity is not a problem in PAN studies where concentrations of less than 50 ppb are anticipated. Some problems were encountered in obtaining accurate dilutions of PAN for standards less than 1 ppb; nevertheless, a linear dose-response relationship was observed (Figure 2). A detection limit of 0.03 ppb and a precision of 0.03 ppb at 1 ppb was obtained for ambient air samples with the Tracor model 560 gas chromatograph.

A chromatogram of an ambient air sample is shown in Figure 3 illustrating the separation of PAN and peroxypropionyl nitrate (PPN) from the major oxygen peak.

The Varian 3700 gas chromatograph was far less sensitive to PAN than the Tracor model 560. This is characteristic of several of

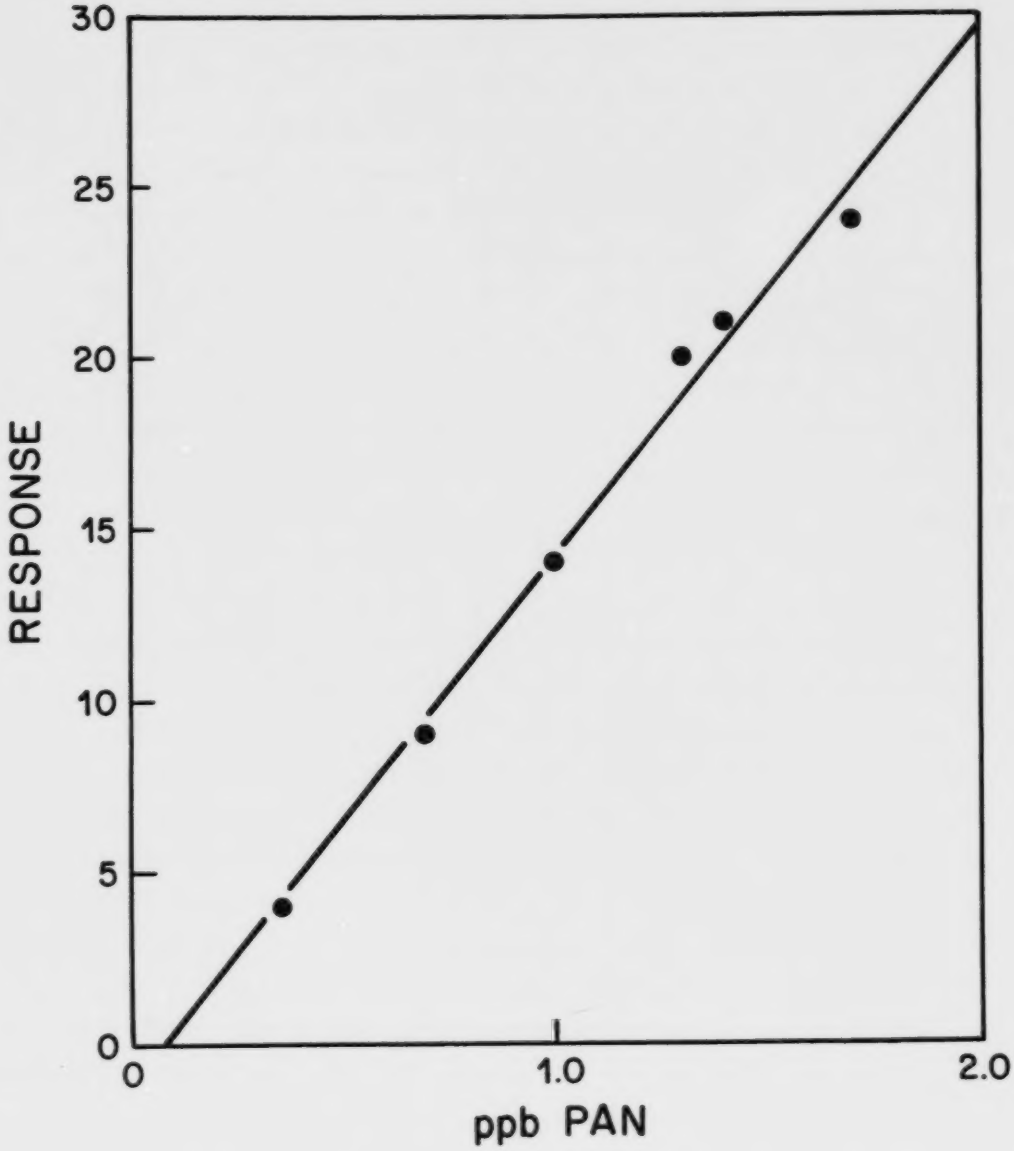

Figure 2. Relationship between gas chromatographic response and PAN concentration.

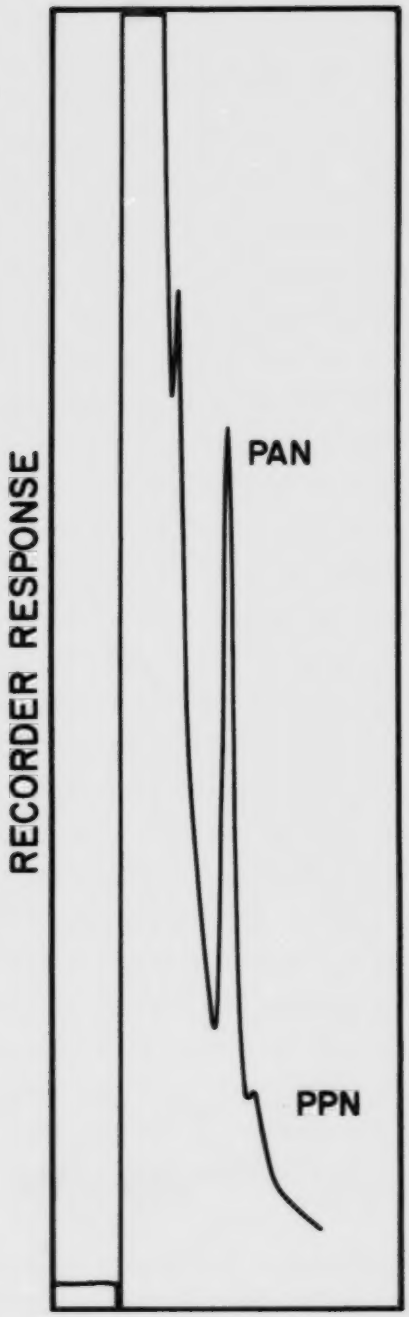

Figure 3. Gas chromatogram of an ambient air sample.

the newer gas chromatographs and is believed to be related to the design of the detector. The sensitivity of ' e system was also limited by the inability of the integrator to discriminate between instrument noise and the onset of a chromatographic peak. These factors combined to produce a detection limit of 0.2 ppb.

3.2 PARTICULATE NITRATE AND SULPHATE AND NITRIC ACID ANALYSIS

3.2.1 Atmospheric Sampling

Two methods of sample collection were used for the determination of nitrate and sulphate in atmospheric particles: (1) collection on 20.3 cm X 25.4 cm paper filters using high volume sampling equipment (1300 L per minute); and (2) collection on 4.7 cm circular Teflon filters using low volume sampling equipment (27 L per minute and 7 L per minute).

High volume sampling using paper filters has the obvious advantage of providing a sample for analysis which is relatively concentrated, having been collected from a large volume of air. This method makes chemical analysis much easier but has several disadvantages, including high "blank" values from the filter itself and rapid loss of permeability during sample collection. The possible conversion of acid gases, particularly nitric acid to nitrate, on the surface of the collection filter is also of concern (Brice et al. 1982; Appel et al. 1978; Fellin et al. 1980).

Low volume sampling has an obvious disadvantage caused by the small amounts of material collected for chemical analysis. Amounts are, however, generally sufficient for analysis by the sensitive ion chromatographic method. The advantage of the low volume sampling system is the use of inert Teflon filters to collect particles, followed by the use of a nylon filter to collect nitric acid.

This stacked configuration of Teflon and nylon filters has been shown to be highly efficient for collecting particulate nitrate and nitric acid, respectively. Teflon filters are very efficient for collection of particulate nitrate with little or no conversion

of nitric acid or other gaseous nitrogenous substances to nitrate (Fellin et al. 1980; Okita et al. 1976; Spicer and Schumacher 1977). Nylon filters have excellent retention of nitric acid and negligable retention of potentially interfering compounds such as NO_2 and PAN (Appel et al. 1981; Joseph and Spicer 1978; Grosjean 1983). Problems, however, may arise with the dual filter system. Ammonium nitrate, a major consitutent of atmospheric particles, may be partially volatilized or decomposed after collection on the Teflon filter (Forrest et al. 1980; Appel et al. 1980; Stelson and Seinfeld 1982) with the products being collected on the nylon filter as nitric acid. This process is favored by the presence of strong acids which react with particles on the Teflon filter during sampling (Forrest et al. 1980; Harker et al. 1977; Appel and Tokiwa 1981). The amount of nitrate occurring as particulate nitrate will be underestimated and the amount of nitrate occurring as nitric acid will be overestimated. The sum of the Teflon filter-collected nitrate and the nylon filter-collected nitrate should represent the total atmospheric inorganic nitrate.

3.2.2 Extraction and Ion Chromatography

One-half of each paper filter was cut into approximately 1 cm squares, placed in a 30 mL beaker, and extracted with 20 mL of triple distilled water. The extraction consisted of ultrasonic vibration for 60 seconds followed by soaking over night with the beaker tightly closed with aluminum foil and an elastic band. Overnight soaking is reported to give 30 per cent better recovery of sulphate as compared with a four-hour soaking (John Menear, Dionex Corporation; private communication). Teflon and nylon filters were extracted whole using 4 mL of triple distilled water. The extract was filtered through a 1 cm circle of Whatman 41 filter paper attached to a 5 mL syringe prior to analysis with a Dionex Model 10 ion chromatograph.

The standard 100 uL sample loop in the ion chromatograph was replaced with a 700 uL loop in order to increase sensitivity.

Anions were analysed with a 3 X 150 mm precolumn coupled to a 3 X 100 mm separator column and a 3 X 250 mm supressor column. The eluent was 0.003 M in sodium biocarbonate and 0.001 M in sodium carbonate with a flow rate of 138 mL per hour. Cations were analysed with a 3 X 150 precolumn, a 6 X 250 separator column, and a 9 X 250 supressor column. The eluent was 0.005 M hydrochloric acid with a flow rate of 115 mL per hour.

Standard solutions were made according to the directions provided by the manufacturer and used to calibrate the instrument. Unused filters were analysed to provide a method blank. The Whatman 41 paper filters contained 17 ug of nitrate and 44 ug of sulphate or, on the basis of a 12-hour sampling period at a flow rate of 500 L of air per minute, 0.047 ug of nitrate per m^3, and 0.12 ug sulphate per m^3. Teflon filters contained 0.12 ug nitrate and 1.16 ug sulphate per filter, and nylon filters 0.44 ug nitrate and 1.20 ug sulphate. These amounts corresponded to 0.025 ug NO_3 per m^3 and 0.24 ug SO_4 per m^3 for the Teflon filter, and 0.092 ug per m^3 NO_3 and 0.25 ug per m^3 SO_4 for the nylon filter, based on a sampling rate of 20 L per minute over a four-hour period.

3.3 ANALYSIS OF THE AMBIENT ATMOSPHERE

3.3.1 Sampling Locations

Two Calgary sampling locations were used in this study,one representative of a residential site and the other a downtown site. The residential location was at the University of Calgary, adjacent to the Biological Sciences Building. The university is in the western part of Calgary about 6 km northwest of the city centre. It is located above the Bow River valley and the sampling site is approximately 1 km from the valley. Air quality at this location is strongly controlled by prevailing winds from the northwest which pass only over residential areas of the city prior to reaching the university. Being close to the river valley, this site also comes under the influence of the catabolic effect of the river valley. On

days with near calm conditions or light winds from the southeast, air quality at the university is affected by pollutants moving from the downtown area.

Samples for the analysis of PAN were taken about 1 m above ground level in a small paved area immediately west of the Biological Sciences Building. Alberta Environment maintains an air quality monitoring station about 1/2 km west of the PAN sampling site. Atmospheric aerosol samples were taken at this location using paper filters with high volume sample collection. Meteorological information is available from the University of Calgary weather station at this location. Nitric acid and atmospheric aerosols were collected using low volume sampling equipment at the Biological Sciences Building location and, for the purposes of comparing methods, high volume aerosol samples were collected at the same location.

The second location was in downtown Calgary at Alberta Environment's air monitoring station in the Court House at 4th Street and 107th Avenue SW. Most air pollution in Calgary is caused by motor vehicle traffic which is concentrated in the city centre. The city centre acts almost like a diffuse point source of pollutants as distinct from an area source. Pollutants are contained within the city centre as a result of its geographical location in the river valley sheltered from the prevailing winds.

A third site, to measure background concentration of PAN, nitric acid,and particulate matter was located at the Kananaskis Centre for Environmental Research, 70 km west of Calgary. This site is in the Kananaskis Valley on the eastern edge of the Rocky Mountains. Samples were taken about 2 m above a grassy area adjacent to the laboratory building. Ozone measurements were also taken and limited information on wind speed and direction, temperature, and relative humidity was available.

3.3.2 Instrumentation and Sampling Frequency

Measurement of PAN was by gas chromatography at the three

locations. The gas chromatograph used at the university was a Tracor model 560, and at the downtown and Kananaskis sites a Varian model 3700 was used. Both instruments were equipped with nickel 63 electron capture detectors. Samples were manually introduced into the Tracor instrument using a 5 mL gas-tight syringe. The Varian chromatograph was equipped with an automated gas sampling system. This system consisted of a Valco gas sampling valve with air actuator and air switch, a 5 mL Teflon sample loop, a Reciprotor pump, and a Valco digital valve sequence programmer. A Hewlett Packard model 3390 integrator was activated by the sequence programmer to report results. A 2 m by 6.4 mm Teflon tube connected the gas chromatograph to an Ace glass manifold used to introduce ambient air into Alberta Environment's air monitoring station.

Samples were taken and automatically analysed every 30 minutes, 24 hours per day, at the downtown sampling site from 1981 July 12 to 1982 April 07. Some 10 530 samples were analysed. At the university, samples were taken during working hours only, generally 0700 to 1600 h MST, each weekday from 1980 November 19 to 1981 August 30. A total of 1310 samples were analysed. Sampling of PAN at the Kananaskis station began in April of 1982 with measurements made from April 21 to April 30 and from May 18 to August 31.

Atmospheric particles for nitrate and sulphate analysis were collected at the University of Calgary weather station on Whatman 41 paper filters using standard high volume air samplers, and were analysed by ion chromatography (Peake 1980). Samples were collected from 1980 November 11 to 1981 February 08 in 12-hour periods, from 0700 to 1900 MST and from 1900 to 0500 MST of the next day. Samples were also collected at the Biological Sciences Building, University of Calgary, using low volume equipment (27 L per minute flow rate) with Teflon and nylon filters for collection of particles and nitric acid. These samples were collected on working days from 0830 to 1200, 1200 to 1600, and 1600 to 0830 of the next day during the period 1982 May 31 to August 31. High volume sampling with paper filters and low volume sampling with Teflon and nylon filters

were carried out concurrently during the period from August 17 to August 25 to allow comparisons between results obtained by the two sampling systems. Experiments to delineate the effect of magnesium oxide denuder tubes on samples collected with Teflon and nylon filters were carried out on February 18 and 19 and on 1982 March 03, 09, 10, and 25 at the University of Calgary's Biological Sciences Building.

Samples were collected at Kananaskis in continuous 12-hour periods, 0500 to 1700 and 1700 to 0500 of the next day, from 1982 August 03 to September 03 using automated low volume equipment (7 L per minute).

4. RESULTS AND DISCUSSION

4.1 PAN CONCENTRATIONS IN THE CALGARY ATMOSPHERE

Full results for the analysis of PAN in the Calgary atmosphere are given in Appendices 9.1, 9.2, and 9.3 and summaries are presented in Tables 1 to 6.

As shown in Tables 7 and 8, mean concentrations of PAN in Calgary were lower than those reported for major cities in the southern United States (Temple and Taylor 1983). The overall mean concentration of PAN at the University of Calgary from 0700 to 1600 h, 1980 December 01 to 1981 August 31 was 0.22 ppb. At the downtown site, where one-half hour samples were taken 24 hours per day from 1981 July 12 to 1982 February 28, the mean concentration of PAN was 0.14 ppb. The mean daily maxima at the niversity was 0.38 ppb whereas at the downtown location it was somewhat higher, 0.59 ppb. The maximum concentration of PAN measured at the university and downtown were 2.4 and 6.6 ppb, respectively.

Most previous studies of PAN in the urban atmosphere have been carried out over shorter time periods, generally a few weeks. During the summer months in Houston, Texas, mean daytime PAN concentrations of about 1.0 ppb with a maximum of 15.6 ppb were recorded (Jorgen 1978). For a one-month period from mid-July to mid-August 1973, Spicer (1974) reported an average of 1.8 ppb PAN in St. Louis, Missouri, with daily maxima averaging 4.6 ppb and a maximum of 19 ppb. By comparison, the August 1981 mean for downtown Calgary was 0.49 ppb, the mean daily maximum was 2.1 ppb, and the maximum recorded was 6.6 ppb. Calgary's atmospheric concentrations of PAN are similar to those reported for northern European cities: Riso, Denmark; Goteborg, Sweden; Delft, Netherlands; Essen, West Germany; and Harwell, England (Table 8). They are far lower than levels measured in the Los Angeles basin where long-term studies have been

Table 1. Ambient atmospheric concentrations of PAN at the University of Calgary sampling site, 1980 December 01 to 1981 August 31. All data in parts per billion (ppb).

Overall Mean	0.22 (1313 observations)[a]
Mean of Daily Maxima	0.38 (n = 175)
Maxima (overall)	2.4 (1981 Aug 14)
Monthly Means	
Dec 1980	0.11 (n = 21)
Jan 1981	0.16 (n = 22)
Feb 1981	0.12 (n = 20)
Mar 1981	0.12 (n = 19)
Apr 1981	0.20 (n = 21)
May 1981	0.35 (n = 11)
Jun 1981	0.26 (n = 20)
Jul 1981	0.30 (n = 22)
Aug 1981	0.40 (n = 22)
Mean of Daily Maxima (monthly)	
Dec 1980	0.13 (n = 21)
Jan 1981	0.33 (n = 22)
Feb 1981	0.15 (n = 20)
Mar 1981	0.22 (n = 19)
Apr 1981	0.29 (n = 21)
May 1981	0.47 (n = 11)
Jun 1981	0.37 (n = 20)
Jul 1981	0.53 (n = 22)
Aug 1981	0.92 (n = 22)
Maxima (monthly)	
Dec 1980	0.29 (1980 Dec 08)
Jan 1981	2.30 (1981 Jan 27)
Feb 1981	0.97 (1981 Feb 27)
Mar 1981	1.16 (1981 Mar 03)
Apr 1981	1.08 (1981 Apr 15)
May 1981	0.73 (1981 May 26)
Jun 1981	0.60 (1981 Jun 16)
Jul 1981	2.00 (1981 Jul 29)
Aug 1981	2.35 (1981 Aug 28)
Mean of Monthly Maxima	1.28 (n = 09)

[a] n = number of days with observations

Table 2. Ambient atmospheric concentrations of PAN at the downtown Calgary sampling site, 1981 July 12 to 1982 February 28. All data in parts per billion (ppb).

Overall Mean	0.14 (9089 observations)[a]
Mean of Daily Maxima	0.59 (n = 213)
Maxima (overall)	6.6 (Aug 14, 1981)
Monthly Means	
Jul 1981	0.24 (n = 11)
Aug 1981	0.49 (n = 31)
Sep 1981	0.23 (n = 28)
Oct 1981	0.02 (n = 23)
Nov 1981	0.01 (n = 30)
Dec 1981	0.00 (n = 31)
Jan 1982	0.08 (n = 31)
Feb 1982	0.12 (n = 28)
Mean of Daily Maxima (monthly):	
Jul 1981	0.82 (n = 11)
Aug 1981	2.05 (n = 31)
Sep 1981	0.97 (n = 28)
Oct 1981	0.28 (n = 23)
Nov 1981	0.08 (n = 30)
Dec 1981	0.03 (n = 31)
Jan 1982	0.08 (n = 31)
Feb 1982	0.44 (n = 28)
Maxima (monthly):	
Jul 1981	3.68 (1981 Jul 29)
Aug 1981	6.55 (1981 Aug 14)
Sep 1981	3.10 (1981 Sep 18)
Oct 1981	1.20 (1981 Oct 07)
Nov 1981	1.25 (1981 Nov 03)
Dec 1981	0.56 (1981 Dec 08)
Jan 1982	0.89 (1982 Jan 25)
Feb 1982	1.78 (1982 Feb 20)
Mean of Monthly Maxima	1.99 (n = 08)

[a] n = number of days with observations

Table 3. Weekly means and maxima of atmospheric concentrations of PAN at the university sampling site, December 1980 to August 1981.

Weekly	MEANS[a]	MAXIMA	MAX. DATE
Dec 01	0.13 (n = 50)	0.22	1980 Dec 01
Dec 08	0.10 (n = 45)	0.29	1980 Dec 08
Dec 15	0.07 (n = 44)	0.10	(Multi-Date)
Dec 22	0.12 (n = 16)	0.19	1980 Dec 22
Dec 29	0.13 (n = 35)	0.65	1981 Jan 021
Jan 05	0.11 (n = 45)	0.19	1981 Jan 07
Jan 12	0.14 (n = 44)	0.24	1981 Jan 16
Jan 19	0.11 (n = 43)	0.14	1981 Jan 23
Jan 26	0.28 (n = 50)	0.30	1981 Jan 17
Feb 02	0.09 (n = 42)	0.15	1981 Feb 03
Feb 09	0.15 (n = 41)	0.47	1981 Feb 11
Feb 16	0.09 (n = 39)	0.09	1981 Feb 16
Feb 23	0.13 (n = 45)	0.97	1981 Feb 27
Mar 02	0.13 (n = 43)	1.16	1981 Mar 03
Mar 09	0.15 (n = 44)	0.45	(Multi-Date)
Mar 16	0.10 (n = 14)	0.15	(Multi-Date)
Mar 23	0.12 (n = 41)	0.26	1981 Mar 24
Mar 30	0.13 (n = 37)	0.18	(Multi-Date)
Apr 06	0.19 (n = 25)	0.27	(Multi-Date)
Apr 13	0.25 (n = 35)	0.11	1981 Apr 15
Apr 20	0.19 (n = 43)	0.36	1981 Apr 22
Apr 27	0.22 (n = 36)	0.45	1981 Apr 27
May 04	NO DATA		
May 11	0.47 (n = 05)	0.58	1981 May 15
May 18	0.34 (n = 20)	0.61	1981 May 20
May 25	0.24 (n = 46)	0.73	1981 May 29
Jun 01	0.26 (n = 41)	0.59	1981 Jun 02
Jun 08	0.22 (n = 32)	0.31	(Multi-Date)
Jun 15	0.26 (n = 23)	0.43	1981 Jun 15
Jun 22	0.31 (n = 40)	0.60	1981 Jun 26
Jun 29	0.24 (n = 29)	0.75	1981 Jun 30
Jul 06	0.19 (n = 47)	0.36	(Multi-Date)
Jul 13	0.34 (n = 28)	0.68	1981 Jul 13
Jul 20	0.21 (n = 36)	0.38	1981 Jul 20
Jul 27	0.44 (n = 50)	2.00	1981 Jul 29
Aug 03	0.55 (n = 34)	2.15	1981 Aug 05
Aug 10	0.50 (n = 41)	1.35	1981 Aug 14
Aug 17	0.26 (n = 30)	1.40	1981 Aug 19
Aug 24	0.30 (n = 36)	1.60	1981 Aug 28
0.70 ppb (n = 38) Mean of Weekly Maxima			

[a]n = number of observations

Table 4. Weekly means and maxima of atmospheric concentrations of PAN at the downtown Calgary sampling site, July 1981 to February 1982. All data in parts per billion (ppb).

Weekly	MEANS[a]	MAXIMA	MAX. DATE
Jul 12	0.25 (n = 14)	0.56	1981 Jul 16
Jul 19	0.30 (n = 60)	0.50	1981 Jul 20
Jul 26	0.44 (n = 177)	3.68	1981 Jul 29
Aug 02	0.58 (n = 284)	5.03	1981 Aug 04
Aug 09	0.88 (n = 226)	6.55	1981 Aug 14
Aug 16	0.22 (n = 193)	2.66	1981 Aug 22
Aug 23	0.29 (n = 288)	4.60	1981 Aug 28
Aug 30	0.28 (n = 314)	2.71	1981 Aug 30
Sep 06	0.11 (n = 335)	2.72	1981 Sep 08
Sep 13	0.05 (n = 295)	3.10	1981 Sep 18
Sep 20	0.05 (n = 336)	0.82	1981 Sep 25
Sep 27	0.02 (n = 49)	0.38	1981 Sep 17
Oct 04	0.22 (n = 336)	1.20	1981 Oct 07
Oct 11	0.00 (n = 298)	0.00	
Oct 18	0.01 (n = 286)	0.72	1981 Oct 29
Oct 25	0.04 (n = 68)	0.72	1981 Oct 29
Nov 01	0.02 (n = 262)	1.25	1981 Nov 03
Nov 08	0.00 (n = 326)	0.00	
Nov 15	0.00 (n = 336)	0.00	
Nov 22	0.00 (n = 336)	0.00	
Nov 29	0.01 (n = 320)	0.64	1981 Nov 29
Dec 06	0.00 (n = 295)	0.56	1981 Dec 08
Dec 13	0.00 (n = 336)	0.00	
Dec 20	0.00 (n = 336)	0.00	
Dec 27	0.00 (n = 336)	0.00	
Jan 03	0.00 (n = 146)	0.00	
Jan 10	0.00 (n = 249)	0.00	
Jan 17	0.00 (n = 264)	0.00	
Jan 24	0.04 (n = 312)	0.89	1982 Jan 252
Jan 31	0.01 (n = 336)	0.63	1982 Feb 05
Feb 07	0.03 (n = 336)	0.67	1982 Feb 12
Feb 14	0.18 (n = 336)	1.78	1982 Feb 15
Feb 21	0.19 (n = 263)	0.60	1982 Feb 26

1.29 ppb (n = 33) Mean of Weekly Maxima

[a] n = number of observations

Table 5. Means of the daily maxima of the atmospheric PAN concentrations at the university sampling site, presented on a weekly basis December 1980 to August 1981.

Date (Week of):	Mean (Weekly Basis) [a]
Dec 01	0.18 (n = 5)
Dec 08	0.17 (n = 5)
Dec 15	0.64 (n = 5)
Dec 22	0.13 (n = 3)
Dec 29	0.13 (n = 3)
Jan 05	0.14 (n = 5)
Jan 12	0.33 (n = 5)
Jan 19	0.02 (n = 3)
Jan 26	0.73 (n = 5)
Feb 02	0.07 (n = 5)
Feb 09	0.32 (n = 4)
Feb 16	0.02 (n = 5)
Feb 23	0.23 (n = 5)
Mar 02	0.73 (n = 5)
Mar 09	0.32 (n = 4)
Mar 16	0.02 (n = 5)
Mar 23	0.18 (n = 5)
Mar 30	0.14 (n = 5)
Apr 06	0.23 (n = 4)
Apr 13	0.48 (n = 4)
Apr 20	0.32 (n = 4)
Apr 27	0.32 (n = 4)
May 04	NO DATA
May 11	0.58 (n = 1)
May 18	0.44 (n = 3)
May 25	0.40 (n = 5)
Jun 01	0.37 (n = 5)
Jun 08	0.38 (n = 4)
Jun 15	0.29 (n = 5)
Jun 22	0.43 (n = 5)
Jun 29	0.42 (n = 4)
Jul 06	0.29 (n = 5)
Jul 13	0.48 (n = 5)
Jul 20	0.30 (n = 5)
Jul 27	1.16 (n = 5)
Aug 03	1.29 (n = 4)
Aug 10	1.11 (n = 5)
Aug 17	0.66 (n = 5)
Aug 24	0.61 (n = 5)

[a] n = number of days with observations

Table 6. Means of the daily maxima of the atmospheric PAN concentrations at the downtown Calgary sampling site, presented on a weekly basis July 1981 to February 1982. All data in parts per billion (ppb).

Date (Week of):	Mean (Weekly Basis)
Jul 12	0.45 (n = 3)
Jul 19	0.28 (n = 5)
Jul 26	1.73 (n = 6)
Aug 02	2.18 (n = 7)
Aug 09	3.18 (n = 6)
Aug 16	1.13 (n = 6)
Aug 23	1.72 (n = 7)
Aug 30	1.09 (n = 7)
Sep 06	0.97 (n = 7)
Sep 13	2.01 (n = 7)
Sep 20	0.34 (n = 7)
Sep 27	0.19 (n = 2)
Oct 04	0.44 (n = 7)
Oct 11	0.00 (n = 6)
Oct 18	0.06 (n = 7)
Oct 25	0.24 (n = 3)
Nov 01	0.28 (n = 7)
Nov 08	0.00 (n = 7)
Nov 15	0.00 (n = 7)
Nov 22	0.00 (n = 7)
Nov 29	0.09 (n = 7)
Dec 06	0.00 (n = 7)
Dec 13	0.13 (n = 7)
Dec 20	0.00 (n = 7)
Dec 27	0.00 (n = 7)
Jan 03	0.00 (n = 7)
Jan 10	0.00 (n = 7)
Jan 17	0.00 (n = 7)
Jan 24	0.39 (n = 7)
Jan 31	0.29 (n = 7)
Feb 07	0.31 (n = 7)
Feb 14	0.79 (n = 7)
Feb 21	0.36 (n = 7)

Table 7. Summary of ambient PAN monitoring in North America.[a] All data in parts per billion (ppb).

City	Sampling Period	Monthly Average	Mean Daily Max	Daily Observation	Reference
East and Mid-West					
Simcoe Ont.	1980 June to Dec	2	-	5.6	Corkum et al. 1982
Hoboken, NJ	1980 June to Aug (1000 to 1600 h)	3.7	-	9.9	Lonneman et al. 1976
New Brunswick, NJ	1978 Sept 30 to Dec 08 (0800 to 1800 h)	2.7	-	10.5	Brennan 1979
Downington, PA	1979 Aug 16 to Sept 20	1	2.2	5.0	Westberg et al. 1978
Wilmington, OH	1974 Aug	-	2.0	4.1	Lonneman et al. 1976
St. Louis, MO	1973 June to Aug (1000 to 1600 h)	6.3	-	25	Lonneman et al. 1976
St. Louis, MO	1973 July 18 to Aug 16	1.8	4.6	19	Spicer 1974
Houston, TX	1976 July 02 to 23 (1000 to 1600 h)	1.0	-	11.5	Jorgen 1978
Houston, TX	1977 June 01 to Oct 31	0.6	-	15.6	Temple and Taylor 1983

continued...

Table 7. Concluded.

City	Sampling Period	Monthly Average	Mean Daily Max	Max Observation	Reference
West					
Calgary, AB residential	1980 Dec 01 1981 Aug 31 (0800 to 1600 h)	0.2	0.4	2.4	
Calgary, AB downtown	1981 July 12 1982 Feb 28	0.1	0.6	6.6	
Salt Lake City, UT	-	-	10 to 20	54	Tingey and Hill 1968
Los Angeles, CA	1965 Sept 1965 Oct	38 60	-	210	Mayrsohn and Brooks 1965
Los Angeles, CA	1968 Sept to Nov (1000 to 1600 h)	-	10 to 30	65.5	Lonneman et al. 1976
West Covina, CA	1973 Aug 24 to Sept 28	8.8	22.4	46	Spicer 1974
Riverside, CA	1967 Aug to Apr (0800 to 1800 h)	4.6	-	58	Taylor 1969
Riverside, CA	1980 Jan to Dec (0800 to 2000 h)	4.9	25.1	41.6	Temple and Taylor 1982

[a](after Temple and Taylor 1982).

Table 8. Summary of world-wide measurements of ambient PAN concentrations (excluding North America). All data in parts per billion (ppb).

City and Country	Sampling Period	Daily Av.	Monthly Av.	Daily Max.	Max. Observation	Reference
Riso, Denmark	1980 June 11 to Sept 23	-	-	0.9	4.2	Nielsen et al. 1981
Goteborg, Sweden	1980 June 9 to 9 Sept	-	-	0.8	3.5	Nielsen et al. 1981
Delft, Netherlands	1973 June to 1972 Nov	0.6	-	1.4	16	Bos et al. 1977
Delft, Netherlands	1973 June to 1973 Oct	2	-	-	ca 20	Guicherit 1976
Essen, W.Germany	1978 June to 1978 Sept	1	1	-	3.6	Bruchman and Eynck 1979
Harwell, England	1974 Nov to 1975 Oct	1	0.27	-	8.9	Penkett et al. 1977
London, England	1974 Aug to 1975 Oct	-	-	-	16.1	Penkett et al. 1977
Central Tokyo, Japan	1973 June 13 to July 13	-	-	-	31.2	Izumikawa et al. 1975
Suburban Tokyo, Japan	1972 July 01 to Aug 31	-	-	-	8.2	Izumikawa et al. 1975
Ohme (50 km NW), Japan	1973 June 13 to July 06	-	-	-	13.5	Bruckman and Eynck 1979
Tokyo, Japan	1972 Sept 20 to Nov 30	-	-	ca. 5	6.7	Fukuda and Terakado 1974

[a](after Temple and Taylor 1982).

carried out. The yearly average at Riverside, California, for 1980 during the hours of 0800 and 2000 was 4.9 ppb, and the highest concentration recorded was 41.6 ppb (Temple and Taylor 1983).

At first glance, it would appear that PAN concentrations, as shown by the overall mean concentrations given in Tables 1 and 2, were higher at the university than at the downtown sampling site (0.22 ppb versus 0.14 ppb). However, the university data included only daytime readings when PAN concentrations are expected to be highest, whereas the downtown data were taken over a full 24-hour period. PAN concentrations were actually higher at the downtown location. For example on 1981 August 14 between the hours of 0800 and 1600 the mean PAN concentration at the downtown site was 2.0 ppb versus 0.84 ppb at the university. On 15 days during July and August 1981, PAN was measured simultaneously at both stations. The mean concentration over these periods was 1.3 ppb at the downtown location and 0.57 ppb at the university, a 2.2-fold greater concentration at the downtown site. It was during this period that the maximum concentrations of PAN were recorded at both the university and downtown locations: 2.4 ppb and 6.6 ppb on August 14. Again, there was more than a two-fold greater concentration downtown.

Many measurements of the PAN concentration at the downtown sampling site fell below the detection limit of 0.2 ppb. These readings were assigned a value of zero when calculating the downtown average PAN concentration. If these readings were assigned a value of 0.1 ppb (one-half the detection limit) and only the period 0700 to 1500 each day was considered, the mean would rise to 0.22 ppb at the downtown site, the same as at the university site.

On days when the highest concentrations of PAN occurred in the ambient atmosphere, small amounts of peroxypropionyl nitrate

(PPN) were also detected (Figure 3). Concentrations of PPN were usually too low to be accurately measured, with the highest value recorded being 0.15 ppb.

4.2 PAN CONCENTRATIONS IN THE KANANASKIS VALLEY

Full analytical results for the Kananaskis atmosphere are contained in Appendix 9.4 and are summarized in Table 9.

Mean concentrations of PAN at the Kananaskis site were low during the summer of 1982 compared with the values obtained over a similar period in 1981 in Calgary. The mean was 0.10 ppb. The mean does not, however, accurately reflect PAN concentrations because many of the measurements were below the detection limit of 0.2 ppb and were calculated as zero. The maximum PAN concentration measured was 2.3 ppb at 2230 on June 24. This compares with a maximum of only 2.4 ppb recorded in the summer of 1981 at the university site in Calgary. Only five measurements out of some 5340 made at Kananaskis were of 2.0 ppb or higher. Three of these readings occurred on June 23 and the other two on June 19. In contrast to the Calgary 1981 situation when high PAN readings were found in August, the August 1982 measurements made at Kananaskis were low.

4.3 DIURNAL VARIATIONS IN PAN CONCENTRATIONS

The diurnal pattern of PAN concentration in the Calgary atmosphere is illustrated in Figures 4 and 5 for the university location, and Figures 6 and 9 for the downtown Calgary sampling site. Peroxyacetyl nitrate generally starts forming between 0800 to 0900 MST in the Calgary area during the summer months. The peak PAN concentration is usually achieved by 1200 or 1300, although on occasion the afternoon peak may be delayed until as late as 1500 h. On days with comparable data, the afternoon maximum of the PAN

Table 9. Number of days with the maximum PAN concentration in the indicated range, Kananaskis Valley, April to August 1982.

	PAN concentration range (ppb)					
Month	0.25	0.25-0.5	0.5-1.0	1.0-2.0	2.0	n[a]
Apr	2	6	2	0	0	10
May	6	1	1	1	0	9
Jun	4	11	9	3	2	29
Jul	14	8	6	3	0	31
Aug	16	11	4	0	0	31
TOTAL	42	37	22	7	2	110

[a]n = total number of days with measurements.

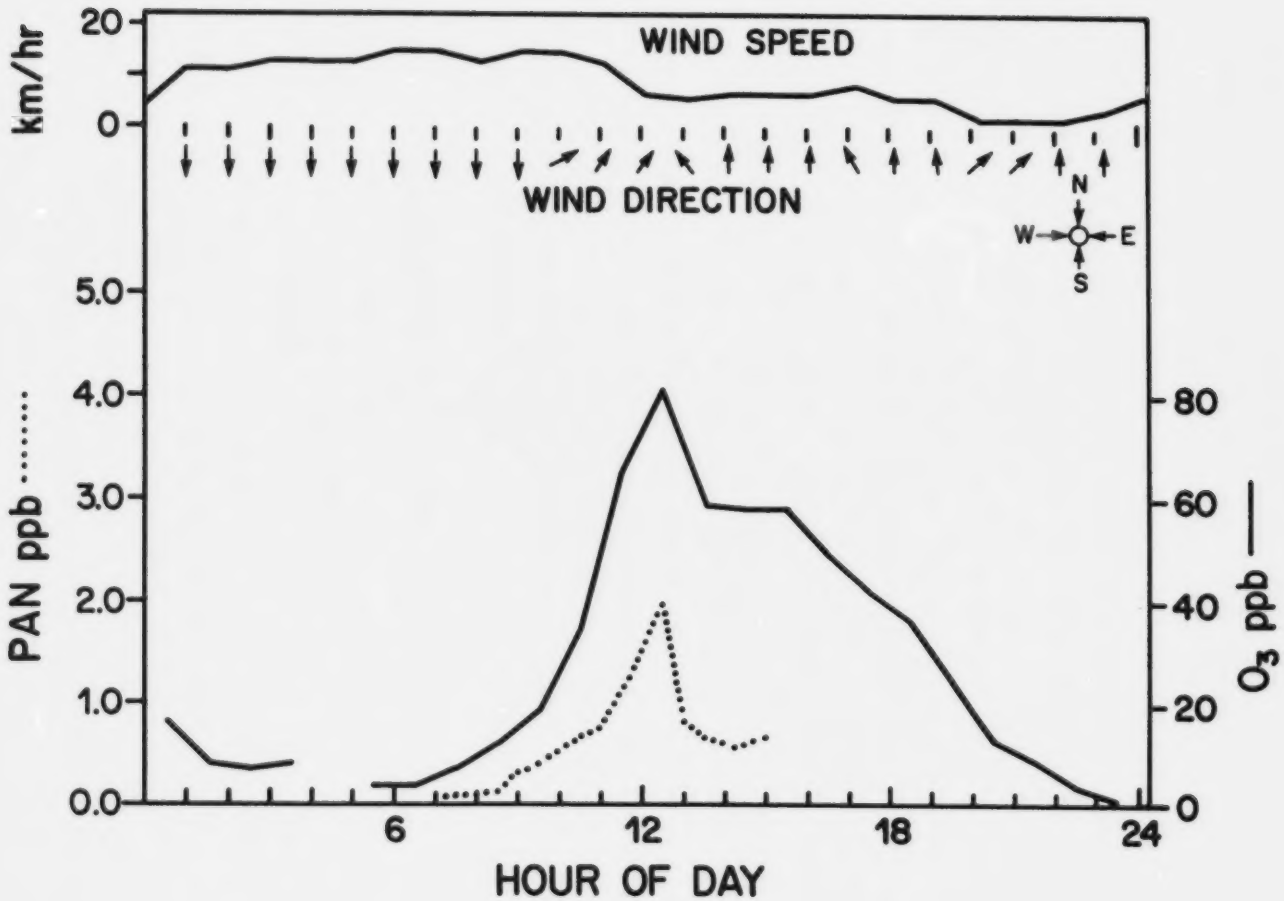

Figure 4. Ozone and PAN concentrations, and wind speed and direction at the University of Calgary, 1981 August 11.

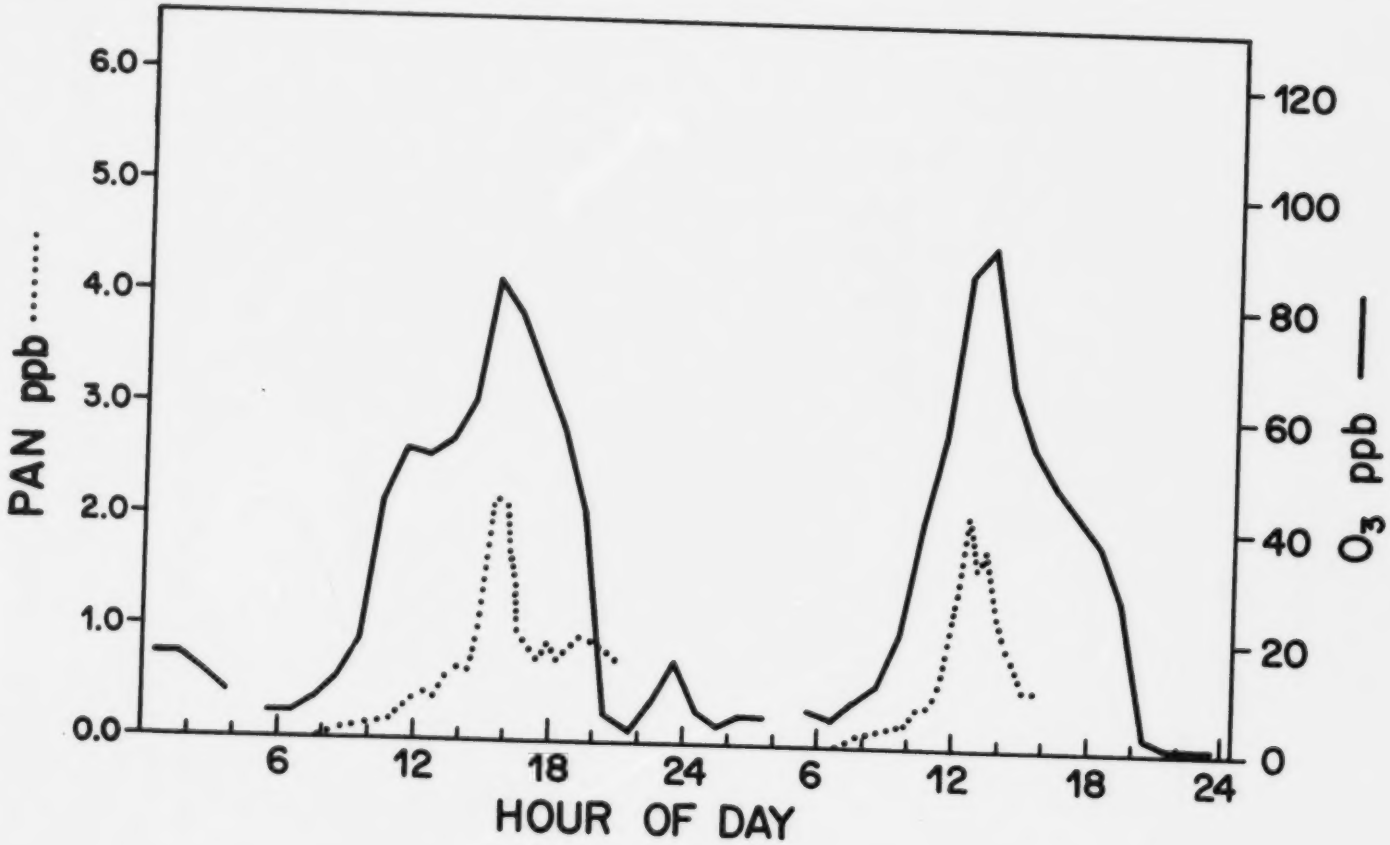

Figure 5. Ozone and PAN concentrations at the University of Calgary, 1981 August 05 and 06.

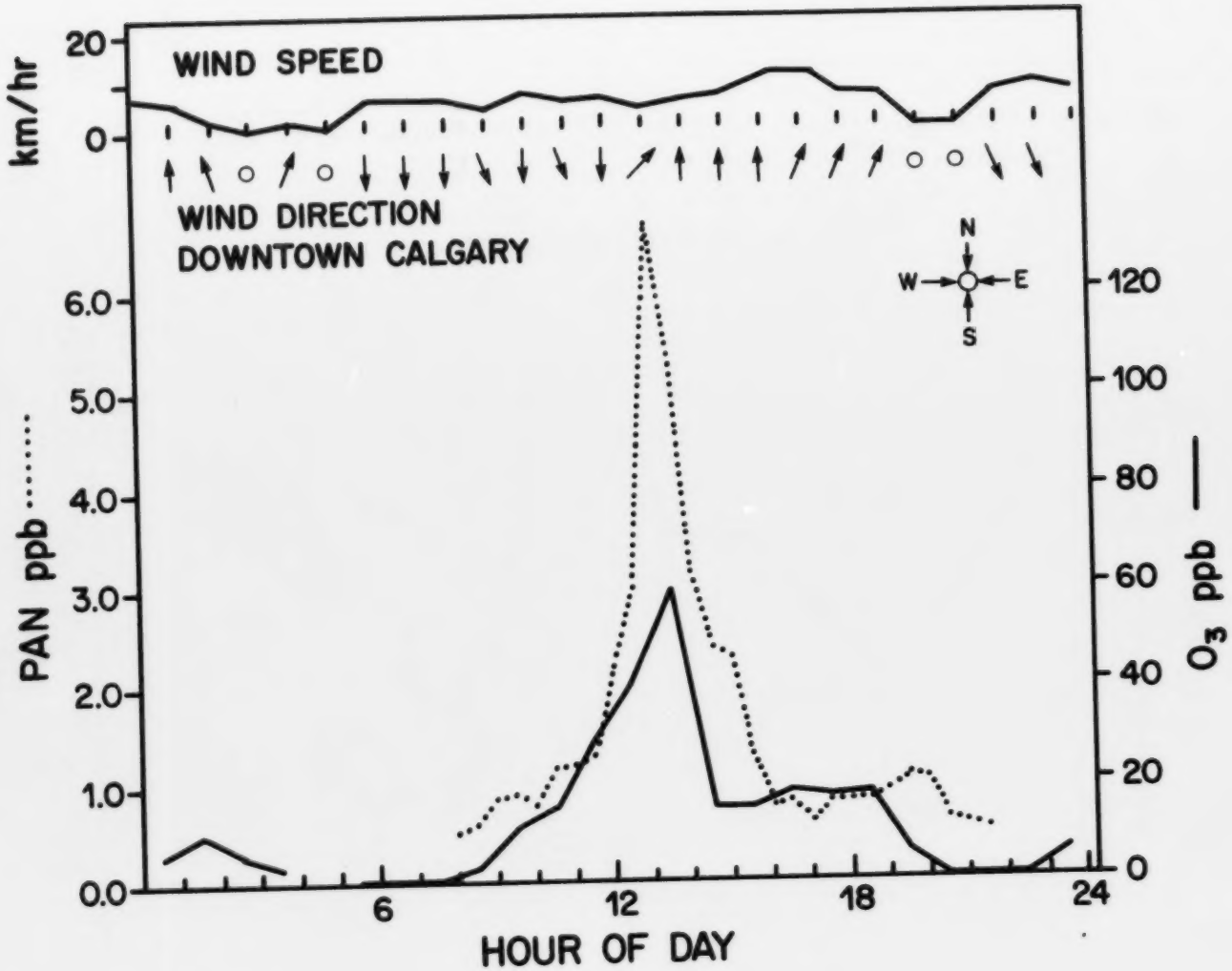

Figure 6. Ozone and PAN concentrations, and wind speed and direction in downtown Calgary, 1981 August 11.

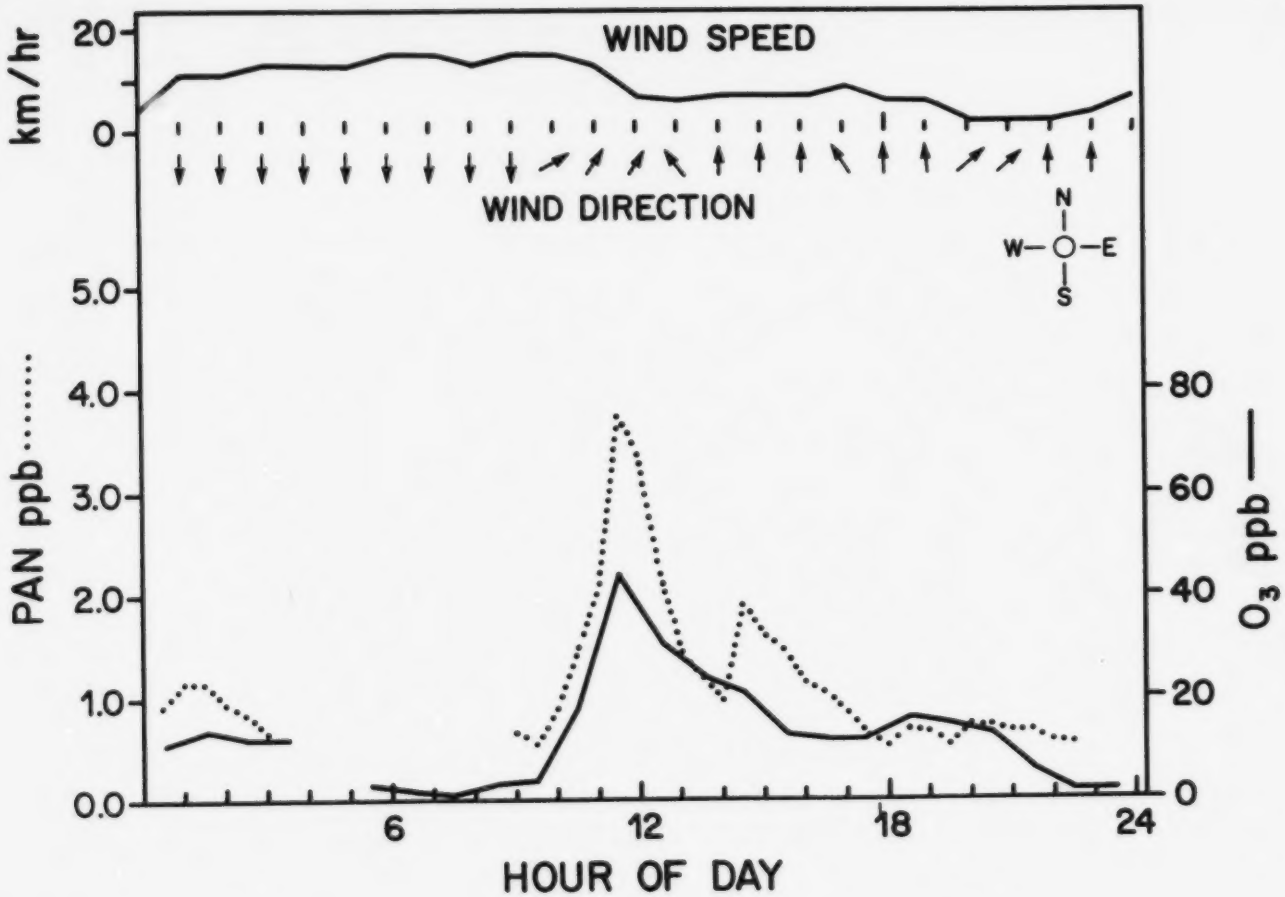

Figure 7. Ozone and PAN concentrations, and wind speed and direction in downtown Calgary, 1981 August 11.

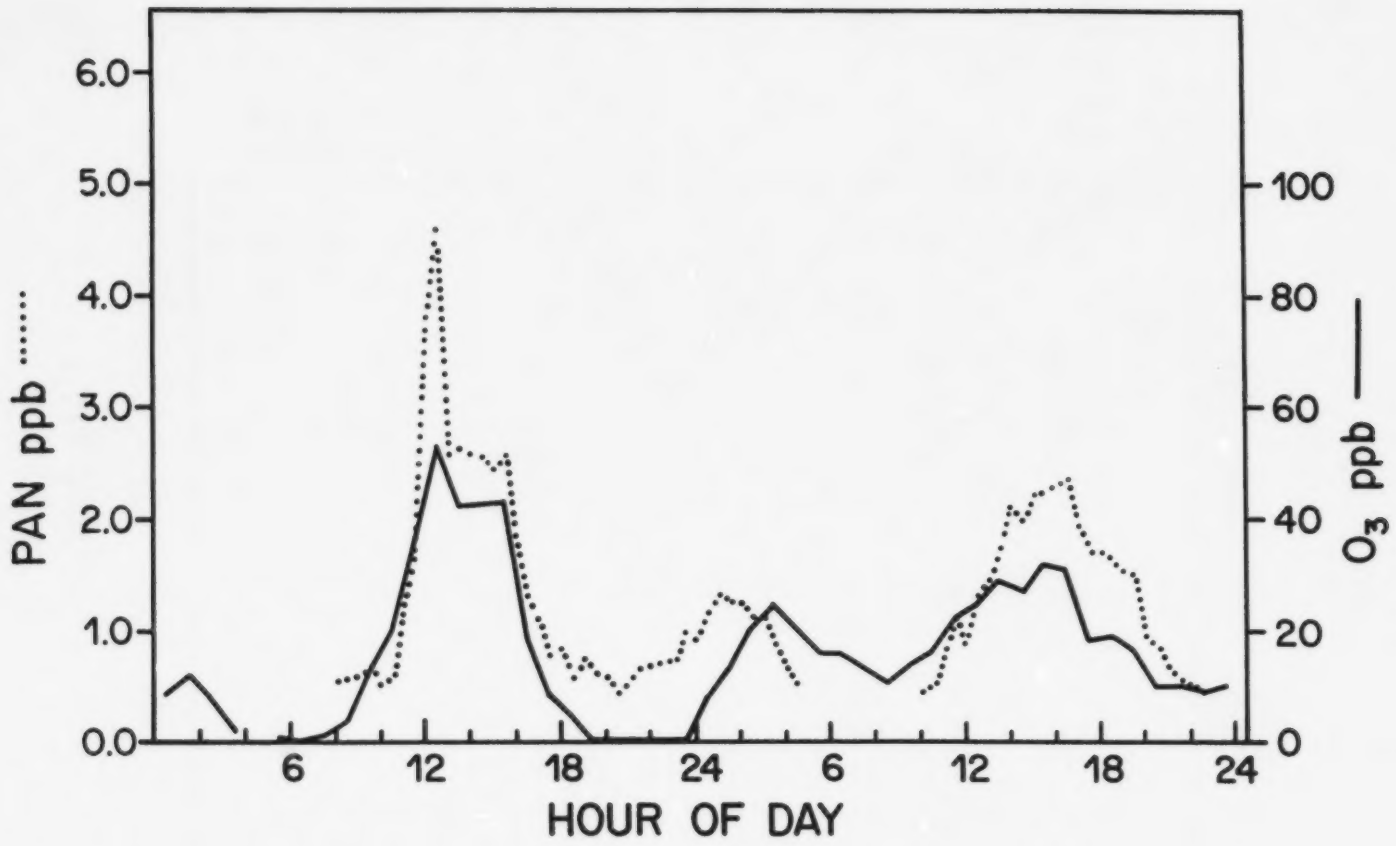

Figure 8. Ozone and PAN concentrations in downtown Calgary, 1981 August 28 and 29.

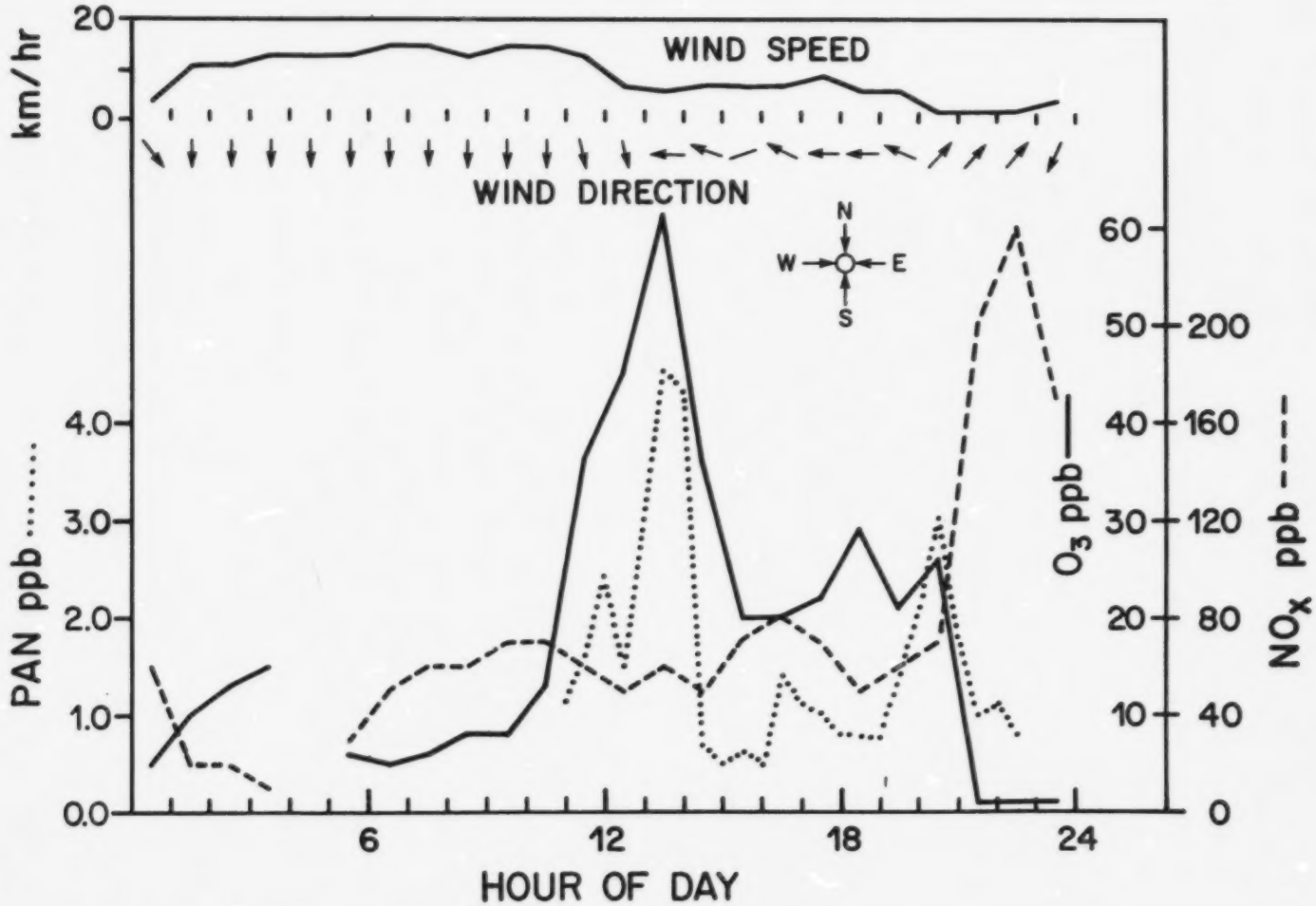

Figure 9. Concentrations of PAN, ozone, and nitrogen oxides, and wind speed and direction in downtown Calgary, 1981 August 10.

concentration occurred at about the same time at both the downtown and University of Calgary locations. This is in contrast to the situation at Riverside, California, where not only are there locally-generated oxidants which reach a maximum by 1000 or 1100 h but, in addition, a "smog front", advected from Los Angeles, which produces a second maximum at about 1500 (Temple and Taylor 1983). The distance between the downtown and University of Calgary sampling sites is relatively small, only 6 km, and such a front effect caused by movement of pollutants from the downtown area to the university may not be distinguishable.

4.4 FACTORS INFLUENCING PAN FORMATION

The formation of PAN is believed to be initiated by the reaction of hydroxyl radicals with olefins or aldehydes to form peroxyacyl radicals. Peroxyacyl radicals react with nitrogen oxides to form peroxyacyl nitrates (Stephens 1969; Lonneman et al. 1976). Thus, a close relationship might be expected to exist between the occurrence of the primary pollutants, nitrogen oxides, and hydrocarbons with that of the secondary pollutants, ozone and PAN. Such a relationship is well known for the nitrogen oxides and ozone; nitric oxide is oxidized to nitrogen dioxide leading to the formation of ozone (National Research Council 1977). It is not the absolute amount of nitrogen oxides which controls the abundance of ozone but, rather, the ratio of the nitrogen dioxide to nitric oxide. The mechanisms of PAN formation are quite different from those of ozone. Peroxyacetyl nitrate is the terminal product of a chain of free radical reactions whereas with ozone the generation process is self-perpetuating.

In Calgary, the primary pollutants (nitrogen oxides, carbon monoxide, and hydrocarbons) show similar diurnal concentration patterns (Figures 10 to 14). The maximum concentration of each occurs at the same time on a given day. The hydrocarbon concentrations, however, show far less variation than do the carbon monoxide and

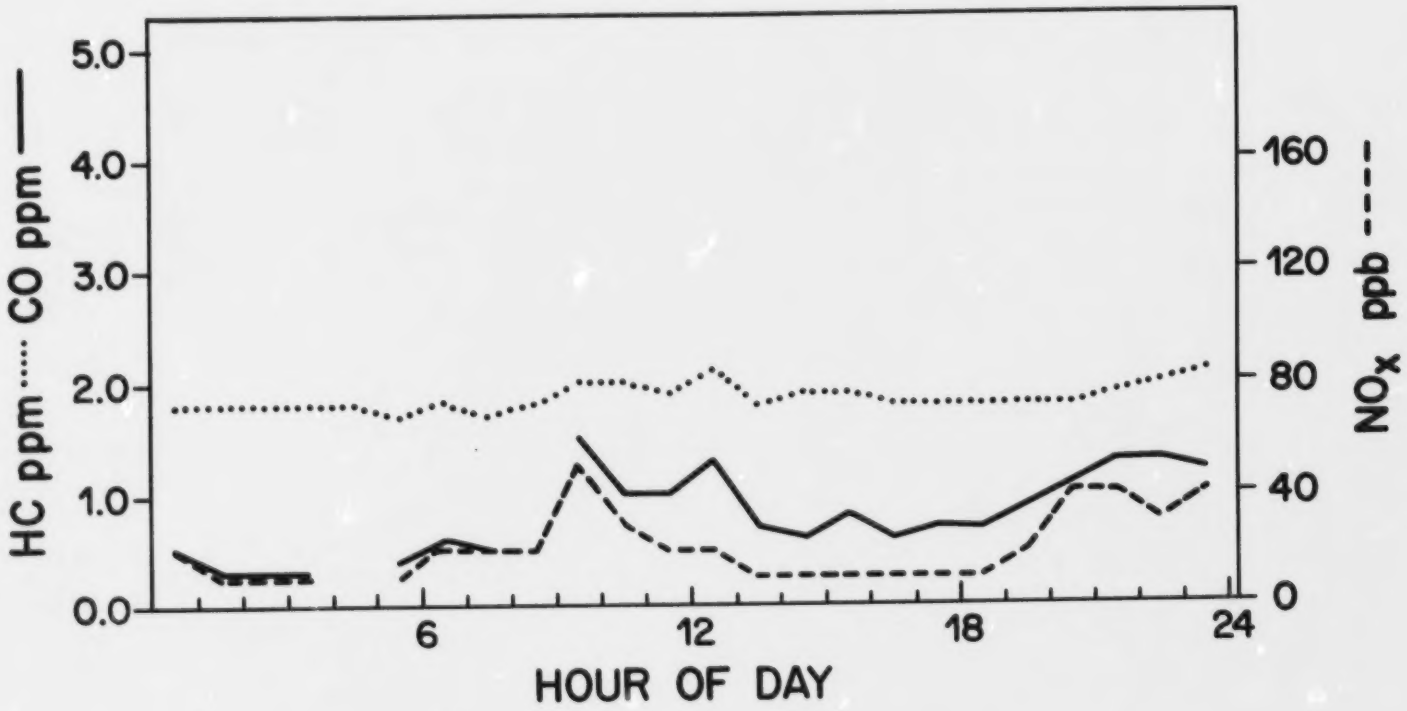

Figure 10. Concentrations of hydrocarbons, carbon monoxide, and nitrogen oxides at the University of Calgary, 1981 August 11.

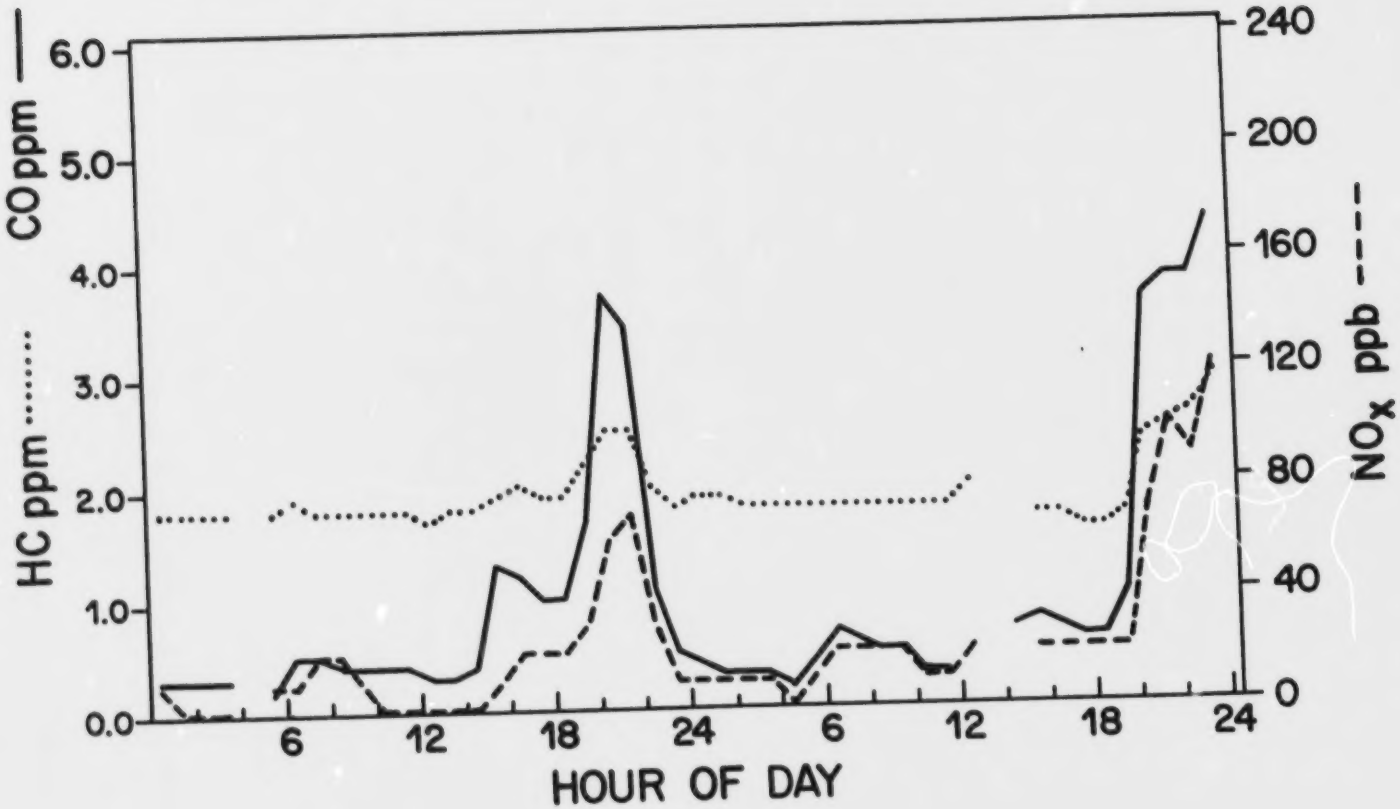

Figure 11. Concentrations of hydrocarbons, carbon monoxide, and nitrogen oxides at the University of Calgary, 1981 August 05 and 06.

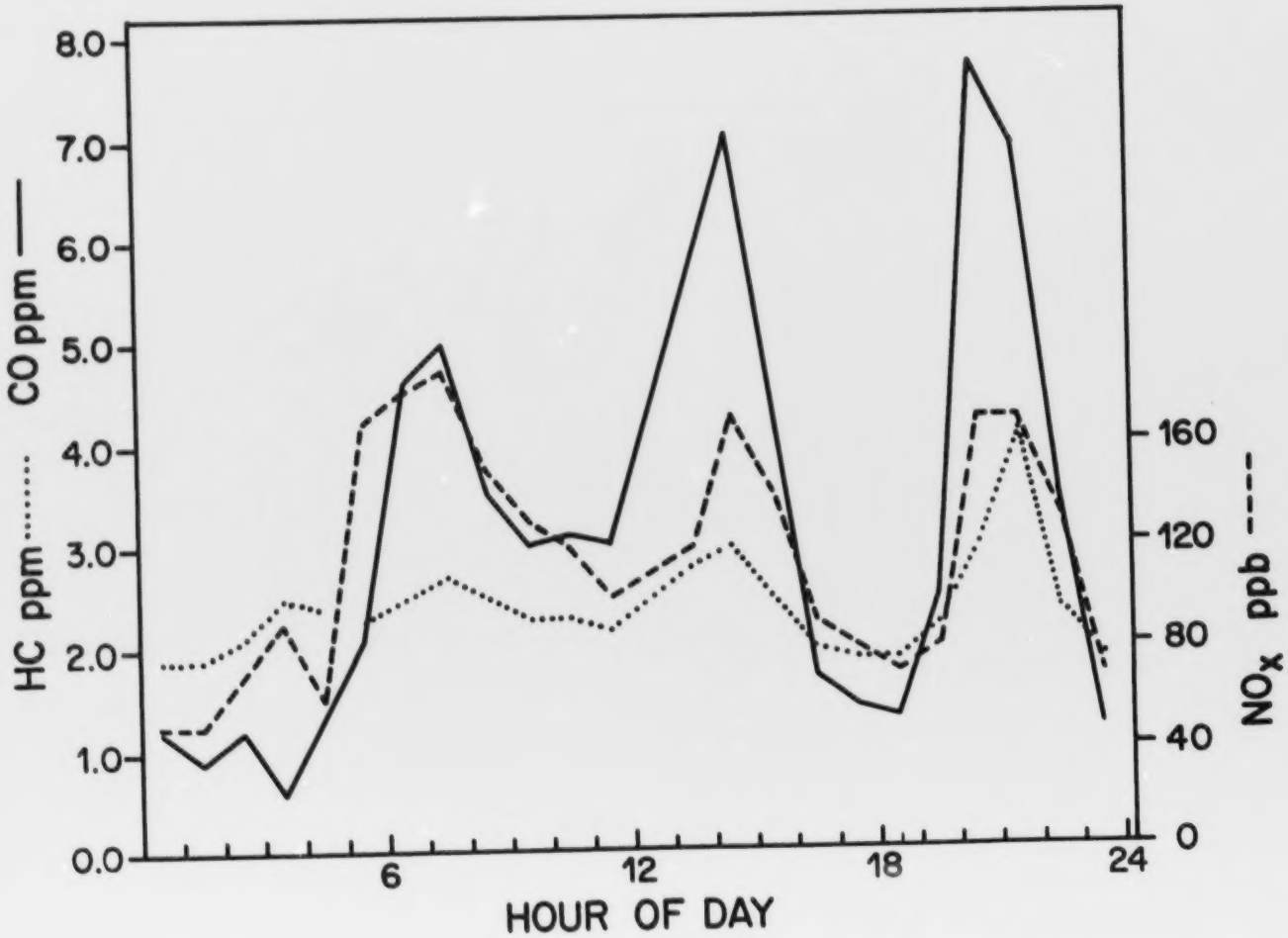

Figure 12. Concentrations of hydrocarbons, carbon monoxide, and nitrogen oxides in downtown Calgary, 1981 August 14.

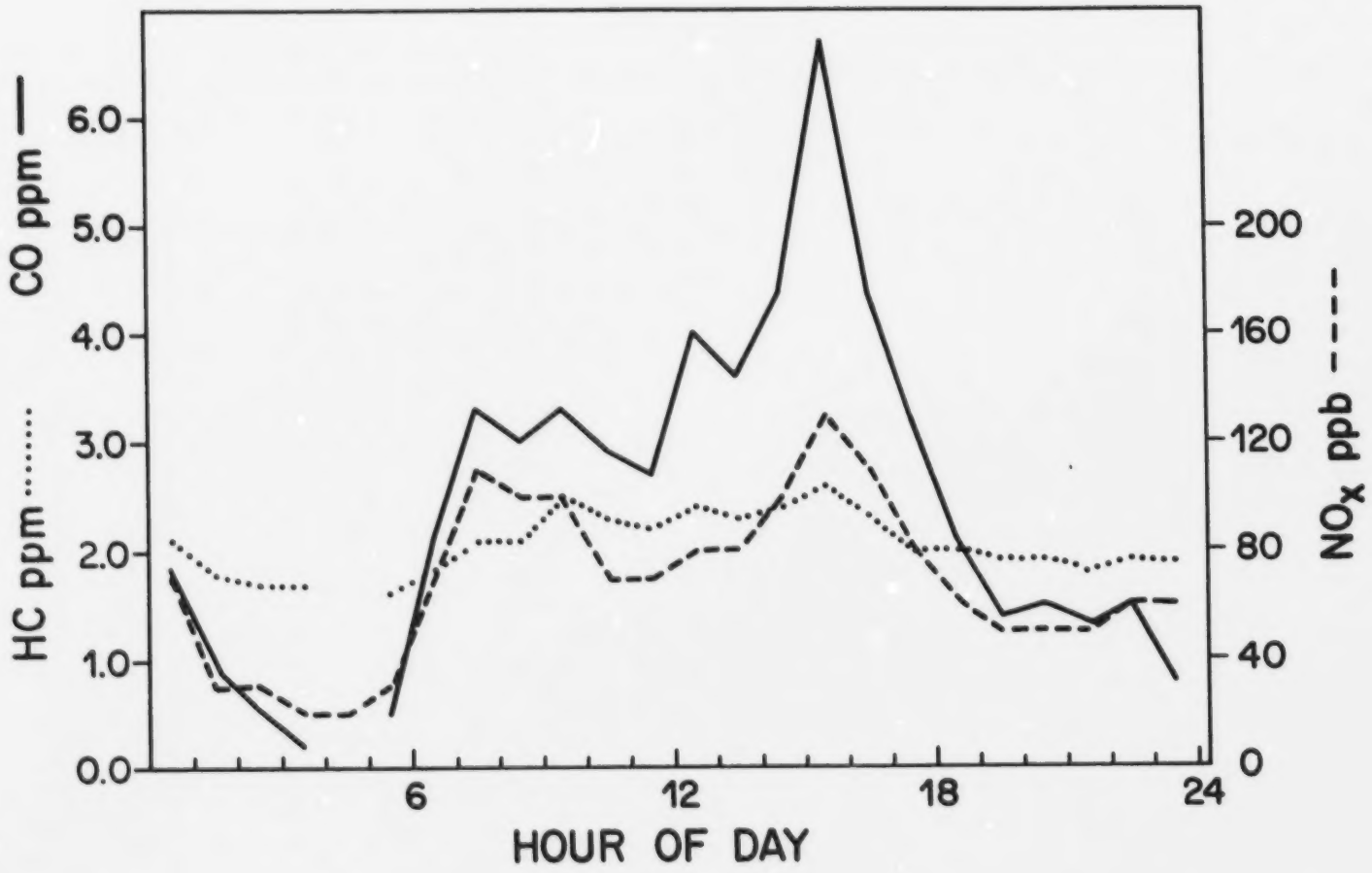

Figure 13. Concentrations of hydrocarbons, carbon monoxide, and nitrogen oxides in downtown Calgary, 1981 August 11.

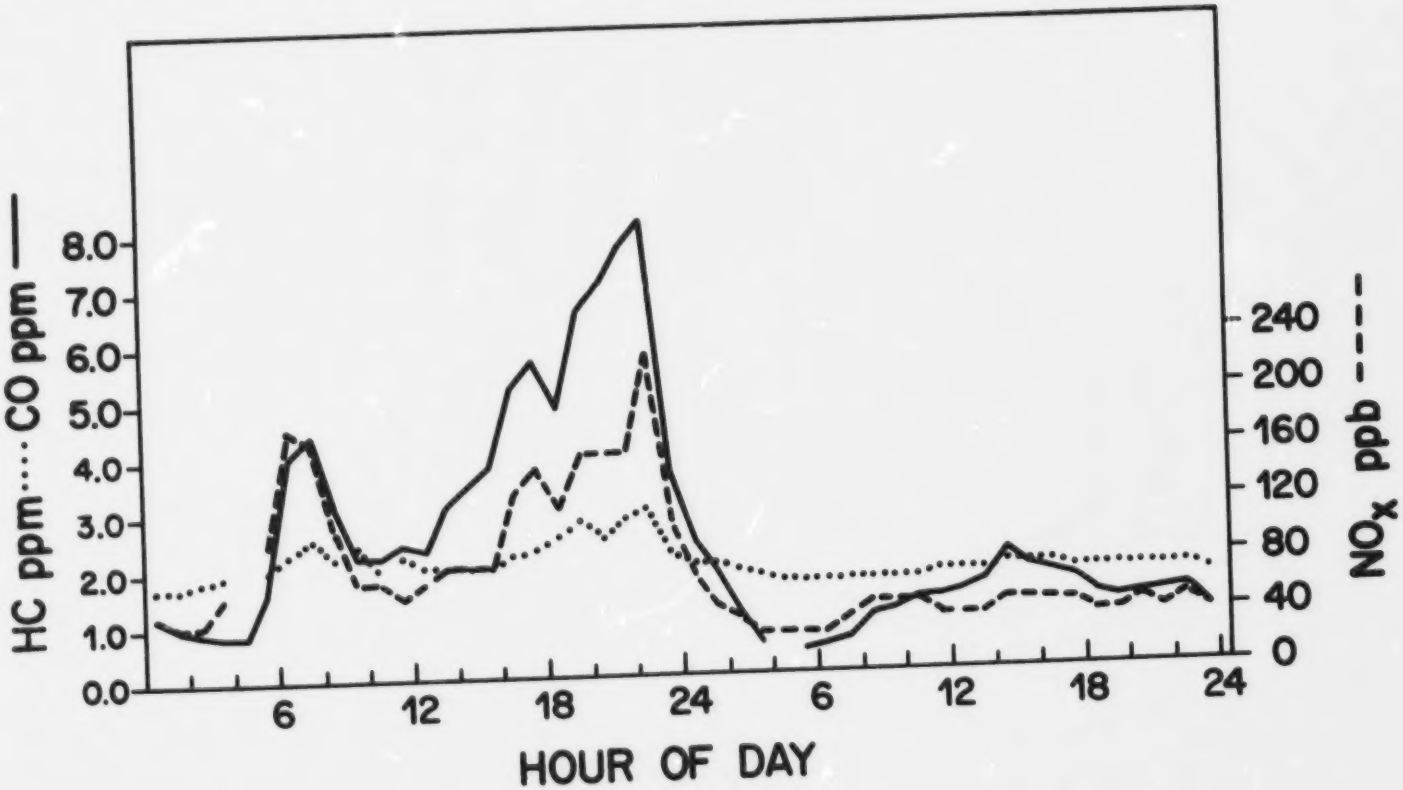

Figure 14. Concentrations of hydrocarbons, carbon monoxide, and nitrogen oxides in downtown Calgary, 1981 August 28 and 29.

nitrogen oxides, with sufficient hydrocarbons available at all times to participate in the formation of peroxyacyl radicals.

As shown by the monthly means in Tables 1 and 2, the highest concentrations of PAN occurred in May and August. This may be explained on the basis of solar radiation intensity and duration, temperature, and pollutant concentrations (Table 10). In the winter, concentrations of primary pollutants are high but the intensity and duration of solar radiation and the atmospheric temperature are low. During spring and autumn, the possibility exists for the simultaneous occurrence of high levels of pollutants and high solar radiation and temperatures, resulting in the generation of PAN. Thus, solar radiation is believed to be the limiting factor in the formation of PAN during the winter in Calgary (51°N), whereas the abundance of the primary pollutants, the precursors of PAN, is the limiting factor in the summer. The results in Calgary contrast with those from the Los Angeles basin (31°N) where evidence suggests that solar radiation is not a limiting factor.

Temperature is one of the factors which influence the rate of PAN generation (Carter et al. 1979). Most PAN measurements have been made in the southern United States where temperatures are warm. Other measurements of PAN have been made mostly during the summer months in the more northerly United States and in Europe. However, PAN was found in Calgary on several days when the temperature did not exceed 0°C. The highest PAN concentrations recorded at the University of Calgary were 2.4 ppb on August 14 and 2.3 ppb on January 27. The maximum temperature on August 14 was 27°C; on January 27 it was only 0°C. On 1982 March 07 the maximum temperature was -4°C but 1.5 ppb PAN was recorded in downtown Calgary.

Meteorological conditions on 1981 January 27 favoured the buildup of high concentrations of pollutants at ground level. (A meteorological report, commissioned as part of this study, is included in Appendix 9.5). The boundary layer height was only 150 m and was believed to be thermally stratified. Winds at two to three meters per second were light, and there was a reversal of wind

Table 10. Monthly mean values of total daily solar radiation on an horizontal surface at Suffield 50°16'N, and mean temperature and mean nitrogen oxides concentration at Calgary 50°50'N, 1977 to 1981.

	Solar radiation $MJ/m^2/day$	Temperature °C	Nitrogen oxides ppm
January	4.94	-10.9	0.13
February	8.56	-7.4	0.12
March	14.03	-4.3	0.09
April	17.87	3.3	0.06
May	21.53	9.3	0.05
June	23.52	13.2	0.04
July	25.06	16.5	0.05
August	20.60	15.2	0.06
September	14.45	10.7	0.08
October	9.29	5.7	0.10
November	5.14	-2.6	0.12
December	3.84	-7.6	0.13

direction at midday. Thus, pollutants would have been trapped beneath the low boundary layer and, because of the low wind speed and reversal of flow, would have stayed within the city for a longer than normal period of time. These conditions led to a high nitrogen oxides concentration of 520 ppb and a mean of 200 ppb NO_x on January 27. The sun angles were low but there was an above-average amount of solar radiation for this time of year. This combination of high concentrations of pollutants and above average (for winter) solar radiation apparently resulted in the formation of relatively high concentrations of PAN (for this season of the year) despite the cold temperatures.

4.5 PARTICULATE NITRATE AND NITRIC ACID CONCENTRATIONS IN CALGARY

4.5.1 Preliminary Studies

Initial studies of the chemical composition of atmospheric particles in Calgary were carried out in 1979 and 1980 (Peake 1980). Samples were collected over a two-week period in March of 1980 and for four days during November and December of 1979 using high volume sampling techniques with Whatman paper filters. Mean concentrations of nitrate and sulphate were 3.5 and 7.8 ug/m^3, respectively, in the atmosphere at a downtown location, and 3.9 and 8.3 ug/m^3 at the University of Calgary. A suite of four samples, taken on 1979 December 03 at the University during a period of relatively high atmospheric pollution, contained 29 ug/m^3 nitrate and 41 ug/m^3 sulphate and indicated that Calgary may experience high concentrations of these ions on occasion. It should be noted that these high concentrations were transitory events which were measured using one-hour sampling periods.

Nitrate, sulphate, and ammonium ions were strongly correlated among themselves but did not correlate well with ambient total nitrogen oxides in the atmosphere. Ammonium was sufficiently abundant to account for almost all the nitrate and sulphate ions in the form of ammonium nitrate and ammonium sulphate. Previous

studies have shown the principal forms of ammonium in the atmosphere to be NH_4NO_3, $(NH_4)_2SO_4$, and NH_4Cl (Yoshizumi and Okita 1983). In Calgary, the abundance of these ions was strongly linked to windspeed, with highest concentrations occurring when winds were light from the southeast and the lowest values recorded when there were strong northwest winds. Samples collected by aircraft upwind, over, and downwind from Calgary showed the existence of an urban plume of pollutants downwind from Calgary even on moderately windy days.

These initial findings were of sufficient interest to warrant further, more extensive, investigations of nitrate and sulphate in the Calgary atmosphere.

4.5.2 Collection on Paper Filters, November 1980 to February 1981

During the three-month period from 1980 November 11 to 1981 February 8, samples were collected at the University of Calgary weather station using the high volume sampling technique with paper filters. In contrast to the preliminary study, continuous sampling with 12-hour or in some cases 24-hour sampling periods were used. Results are presented in Appendix 9.6.1. The mean nitrate and sulphate concentrations over this three-month period were 1.7 ug/m^3 and 3.0 ug/m^3 respectively. The highest values recorded were 44 ug/m^3 SO_4 and 11 ug/m^3 NO_3. The means are low compared with values for other major cities which were determined by similar high volume techniques (Table 11). Only 21 of the 141 SO_4 readings and eight of the 139 NO_3 values were above 5 ug/m^3.

4.5.3 Effect of Paper Versus Teflon Filter Sample Collection

Although paper filters are not believed to convert nitrogen oxides into nitrate they may collect other gases, particularly nitric acid, PAN, and sulphuric acid. An intercomparison study was carried out using high volume sampling equipment with paper filters and low volume sampling equipment with a Teflon filter and a nylon backup filter. The ambient atmosphere was sampled for periods of

Table 11. Concentrations of pollutants reported from various sites in the UK, Europe, and North America.

$SO_4^=$	NO_3^-	NH_4^+	Site	Notes	Source
(ug/m^3 of air)					
32.3	5.4	2.0	London	Mean 24 h average, April to June, 1970	Lee et al. (1974)
6.1	1.9	0.4	Harlow (rural)		
13.8	2.4	1.1	Salford		
12.6	2.2	0.5	Kinder (rural)		
5.8	0.7	0.2	Eskdalemuir (rural)		
7.3	2.7	7.3	UK	Average and range of mean concentration at 7 sites for March to Dec. 1973	Cause (1974)
0.4 to 4.7	0.6 to 4.4	1.6 to 10.6			
11.1 to 18.3	2.2 to 3.7	4.0 to 6.3	Teeside	Range of mean values at 5 sites on days of reduced visibility	Eggleton (1976)
3.3.3.0	3.8.4.3		Harwell	Yearly averages for 1973, 1974	Eggleton (1976)
6.6			Arnhem	Mean 6 h averages (1100 to 1700) June to August 1976	Eishout et al. (1975)
10 to 11			Rotterdam		
			Rotterdam	Range of annual mean 1966 to 1972	Doleman et al. (1975)
0.29			N. Europe	Mean for remote sites in Europe	Meszaros (1978)
7.5 to 9.0			W. Europe		
5.3 to 14(E)			US	Range of annual averages for rural sites	Greenley et al. (1975)
ave. 8.1					
0.5 to 5.3(W)					
7(E)				Annual averages for urban sites	
13.5(W)					
2.0 to 41	0.4	0.1 to 11.5	York City	Range July to August 1976	Leadever et al. (1978)
12	9	2	California cities	Mean for 1968	O'Brien et al. (1975)
3.1 to 13.1	1.0 to 7.8		Ontario	Range of annual geometric means for 43 urban sites, 1976	Heidron (1978)
2.0	1.0	0.8	Edmonton	mean November 1978	Klemm and Gray, (1982)
2.0			Global average		Greenley et al. (1975)
	0.2	1.0	Global average		Robinson & Robins (1970)
			Global average	Over land	
1.1 to 40.8	0.4 to 29.4	0.1 to 11.7	Calgary, Alberta	Range, 9 days during December 1979 and March 1980	Peake (1980)
3.0	1.7	1.6	Calgary, Alberta	Mean November 1980 to February 1981	

three to four hours, twice a day between the hours of 0800 and 1600 for one week. The results are given in Table 12.

The total nitrate value for low volume sampling is the sum of the nitrate collected on the Teflon and the nylon filters. In all cases, substantially lower amounts of nitrate and sulphate were collected by the low volume technique. The mean sulphate values for low volume and high volume samples were 0.22 ug/m^3 and 1.50 ug/m^3 respectively and the nitrate values were 0.31 ug/m^3 and 1.75 ug/m^3. Apparently, either substantial amounts of gases were collected and converted to nitrate and sulphate on the paper filter or there were substantial losses in the Teflon nylon filter system. The most likely source of error is the conversion of gases to nitrate and sulphate on the paper filter. The implication is that the previously reported values for particulate nitrate and sulphate in the Calgary atmosphere are maximum values and the actual concentrations are considerably less.

During eight of the periods when both high volume and low volume samples were taken, PAN measurements were also made. Average PAN concentrations for the period were converted from ppb into ug of NO_3 per m^3 of air. In five of the eight periods, conversion of PAN to NO_3 on the surface of the high volume filter would more than account for the observed nitrate. In the other three cases, conversion of PAN to NO_3 would account for a substantial portion of the observed nitrate.

4.5.4 Collection on Teflon and Nylon Filters, June to August 1982

During the period 1982 June 01 to August 24, the atmosphere was sampled in Calgary using low volume (27 L per minute) sampling techniques. The sampling periods were 0800 to 1200 and 1200 to 1600 each day, followed by overnight sampling from 1600 to 0800 of the next day. The results are presented in Appendix 9.6.2. Mean total nitrate concentrations were low (0.51 ug/m^3). The highest total nitrate value recorded during this period was 6.2 ug/m^3

Table 12. Comparison of total sulphate and total nitrate collected by low volume and high volume sampling systems (ug/m^3).

	Period	Total Sulphate Low Volume	Total Sulphate High Volume	Total Nitrate Low Volume	Total Nitrate High Volume
82-08-17	0820 to 1200	0.23	2.54	0.79	4.38
	1202 to 1558	0.58	2.32	1.87	8.01
82-08-17/18	1600 to 0825	0.10	0.60	0.09	0.99
82-08-18	0833 to 1155	0.07	4.67	0.10	1.38
	1200 to 1601	0.07	2.59	0.28	2.74
82-08-18/19	1607 to 0800	0.19	1.23	-	-
82-08-19	0800 to 1205	0.10	1.46	-	-
	1209 to 1601	0.02	1.51	-	-
82-08-19/20	1608 to 0830	0.16	1.09	0.12	0.39
82-08-20	0830 to 1153	0.51	1.34	0.63	1.76
	1155 to 1602	0.32	1.23	0.27	2.63
82-08-23	0840 to 1153	0.21	0.74	0.02	-
	1155 to 1600	0.06	0.79	0	0.17
82-08-23/24	1604 to 0830	0.71	2.50	0.05	1.43
82-08-24	0825 to 1145	0.20	0.82	0.03	0.31
	1155 to 1600	0.06	0.48	0.20	0.18
82-08-24/25	1605 to 0840	0.22	0.55	0.06	0.34
82-08-25	0845 to 1150	0.23	0.73	0.39	0.30
	1155 to 1603	0.14	1.24	0.05	1.30

and the highest nitric acid value was 2.5 ug/m^3. The mean nitric acid value was 0.26 ug/m^3. Total nitrate concentrations were highest during the daytime sampling periods: 0.58 ug/m^3 NO_3 compared with 0.32 ug/m^3 NO_3 at night. The concentrations of total nitrate in the Calgary atmosphere are low compared with values reported for cities in Eastern Canada (Barrie et al. 1981). The mean nitrate concentration, measured at the CN Tower in Toronto over an 11-month period between June 1979 and June 1980, was 2.94 ug/m^3 compared with 0.51 ug/m^3 recorded in Calgary. The ratio of nitrogen collected on the Teflon filter compared with the nylon filter varied widely, indicating that the form of nitrogen (particulate NO_3, HNO_3, or PAN) also varied considerably (see section 4.7). The average Teflon to nylon filter nitrate ratio was 2.4:1.

4.6 NITRATE AND NITRIC ACID IN THE KANANASKIS VALLEY

Samples were collected with low volume equipment (7 L per minute) for the month of August 1982 in the Kananaskis Valley. The results are presented in Appendix 9.7. The mean total nitrate concentration was 0.35 ug/m^3, consisting of 0.13 ug/m^3 collected on the Teflon filter and 0.22 ug/m^2 on the nylon filter. Nitrate and nitric acid collected on the Teflon and nylon filters were both higher during the daytime sampling periods compared with nighttime sampling. During the day the average amount of nitrate collected on the Teflon filter was 0.23 ug/m^3 compared with 0.09 ug/m^3 at night. Similarly, during the day 0.24 ug/m^3 of nitric acid was collected on the nylon filter compared with 0.20 ug/m^3 at night. The ratio of Teflon to nylon filter collected NO_3 was highest during the night, 0.83 compared with 0.66 during the day, indicating that a greater proportion of the nitrogen occurred as nitric acid during daylight hours.

4.7 OZONE-PAN RELATIONSHIPS

The photochemical oxidants, PAN and ozone, are generated by related photochemical processes, and in Calgary each usually reach

maximum concentrations simultaneously in the early afternoon (Figures 4 to 9). Spicer 1982 noted a similar correspondence between ozone and PAN in California studies.

The peak afternoon concentration of PAN is much less than the corresponding ozone maximum. During episodes of high concentrations of photochemical smog in Los Angeles or in Japan, ozone/PAN ratios of 10 have been reported (Taylor 1969; Izumikawa et al. 1975). In Europe, ratios are commonly 50 (Nieboer and Van Ham 1976; Brasser et al 1977; Penkett 1978). In downtown Calgary, ratios as low as one were measured (Table 13). Such low ratios occurred when the background concentration of ozone was first suppressed by nitrogen oxides followed by photochemical ozone and PAN formation. Ozone/PAN ratios at the university were generally higher than downtown. On August 14, the day of maximum PAN concentrations both downtown and at the university, the ratio was 33 at the university compared with nine downtown. The mean ratio for fourteen days when PAN was measured both at the university and downtown, was 65 at the university and 21 downtown. Overall ozone concentrations are higher at the university than downtown (means for 1981 of 18.3 ppb and 10.3 ppb respectively), reflecting the university location upwind of the major transportation sources of nitrogen oxides. Downtown Calgary ozone concentrations are supressed by nitric oxide emissions. During the winter months, low ozone/PAN ratios may result on days of relatively high pollution, even at the university, from suppression of ozone by nitric oxide rather than from high PAN concentrations. For example, on January 27, a ratio of four was measured at the university. The PAN concentration was 2.3 ppb while the ozone concentration was only 10 ppb.

Comparison of the primary pollutant concentrations, with the corresponding ozone and PAN concentrations, showed the generation of ozone and PAN after a decline in the concentration of nitrogen oxide (Figures 4 and 10). In some cases, however, PAN maxima coincided with maximum concentrations of the primary pollutants. On 1981 January 27, high nitrogen oxide concentrations were

Table 13. Ozone:PAN ratios on selected days at the University of Calgary and in downtown Calgary.

	University	Downtown
1981 Jan 2	38	-
1981 Jan 27	4	-
1981 Jul 29	35	12
1981 Aug 6	43	17
1981 Aug 14	33	9
1981 Aug 25	120	31
1982 Jan 25	-	1
1982 Feb 15	-	7

recorded at the university and the maximum PAN concentration of 2.3 ppb occurred simultaneously with a maximum of 520 ppb nitrogen oxides (Figures 15 and 16).

Generally, only one peak in the PAN concentration occurred each day, usually during the afternoon, but on occasion a second peak occurred later in the day. On August 10 a secondary PAN maximum occurred at 2030 h (Figure 8). This would suggest either that sufficient peroxyacyl radical existed to allow the generation of PAN to proceed after dark (Lonneman et al. 1976), or that an air mass moved from the downtown area of the city during the afternoon and returned in the evening to produce a second PAN peak. Air moves along the river valley in Calgary in response to adiabatic heating and cooling. A meteorological study (Appendix 9.5) indicated that this type of air mass movement may have occurred.

At Kananaskis on 1982 June 19, PAN concentrations climbed steadily from 0.31 ppb at 0800 to a maximum of 2.2 ppb at 1430 followed by a decline to 0.32 ppb by 2130. Ozone concentrations followed the PAN trend rising from 28 ppb at 0800 to a maximum of 64 ppb at 1430, concurrent with the maximum in the PAN. Ozone then declined to 26 ppb by 2130. The 64 ppb measured on this date was the highest ozone value recorded at Kananaskis from 1982 April 13 through August 31. On June 23, PAN concentrations increased from 0.32 at 1100 to a maximum of 2.3 ppb at 2130 before declining to 0.35 ppb at 2400. Ozone concentrations followed the same general trend, rising rapidly from 9 ppb at 0600 to 32 ppb at 0930 and to 40 ppb at 2030 (Figure 17).

Because the photochemical oxidants PAN and ozone are generated by related photochemical processes, the concurrent occurrence of diurnal maxima in their concentrations is to be expected. When the PAN concentration at Kananaskis exceeded 1.0 ppb, the PAN and ozone maxima occurred concurrently despite considerable variation in the time when the maximum was reached. At Kananaskis, the daily peak in ozone and PAN occurred between 1330 and 1630.

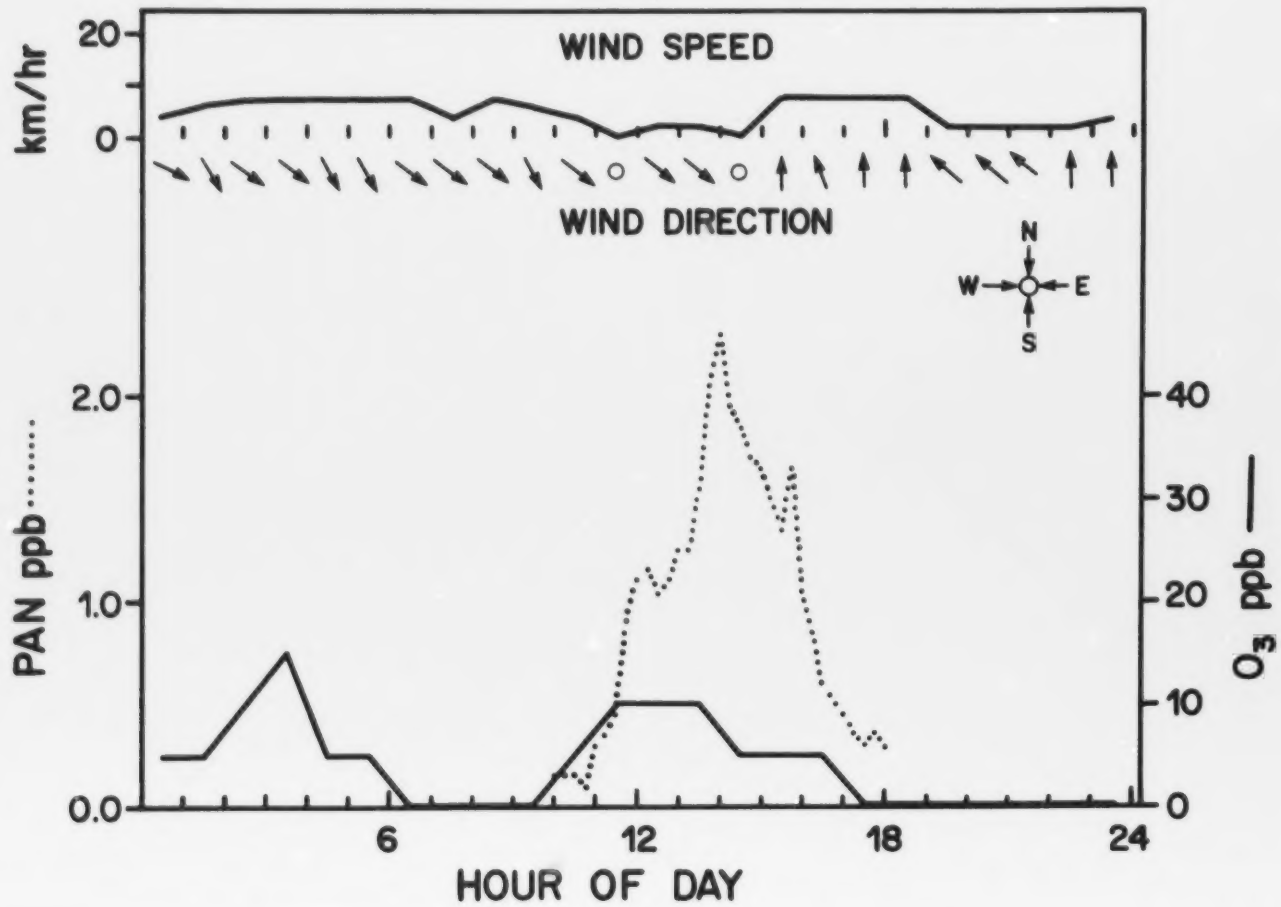

Figure 15. Ozone and PAN concentrations, and wind speed and direction at the University of Calgary, 1981 January 27.

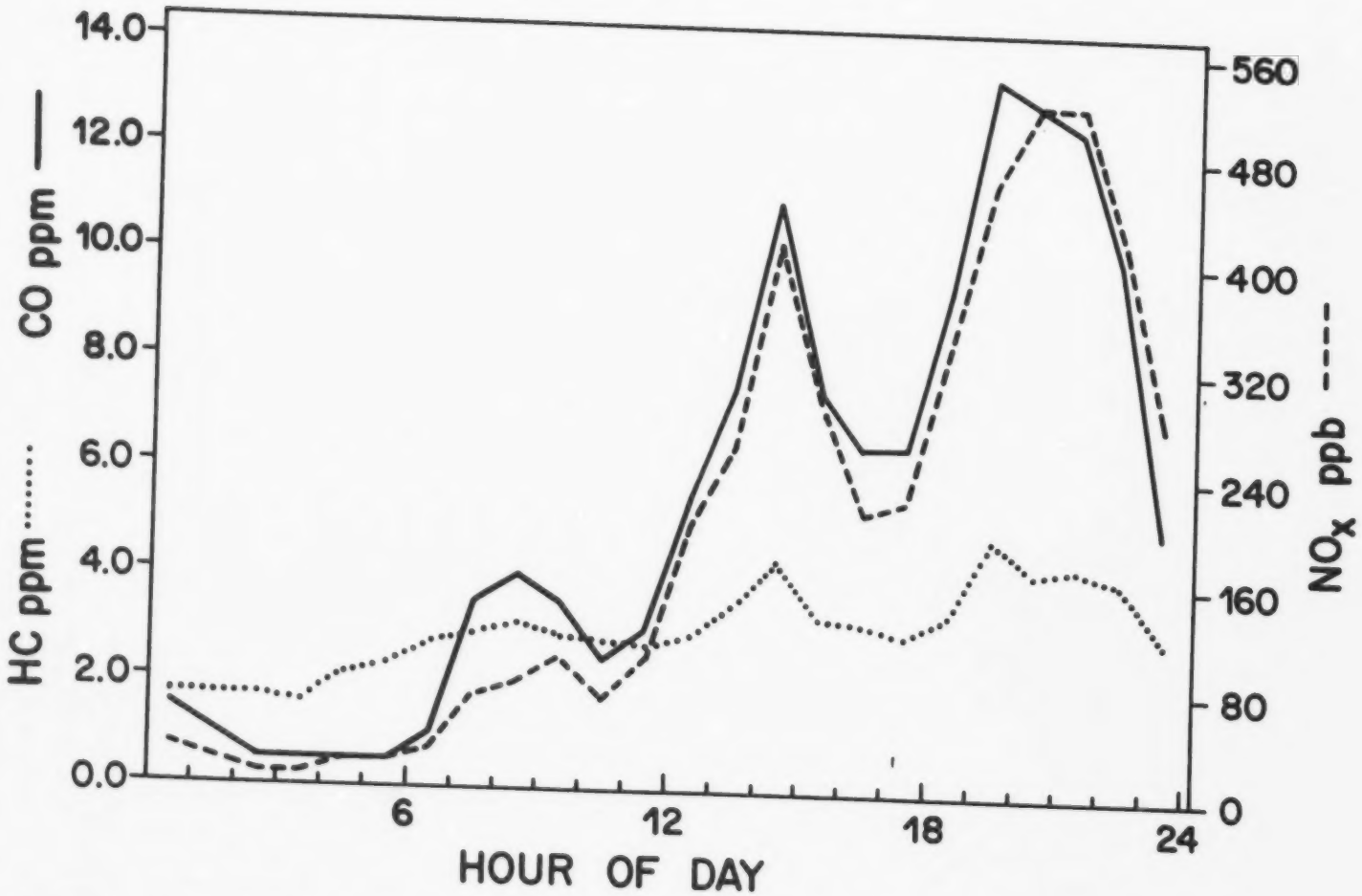

Figure 16. Concentrations of hydrocarbons, carbon monoxide, and nitrogen oxides at the University of Calgary, 1981 January 27.

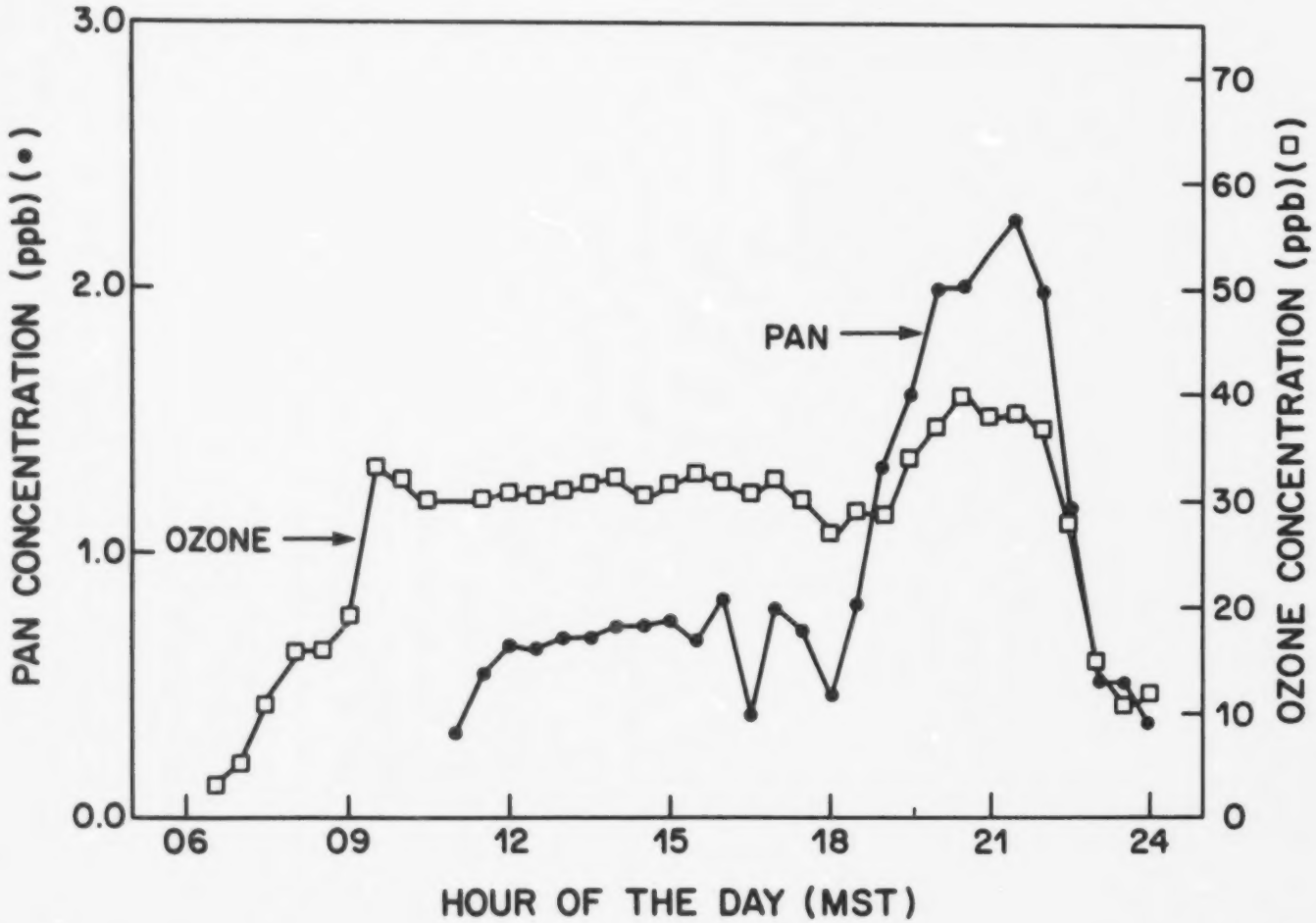

Figure 17. Ozone and PAN concentrations at the Kananaskis Field Station, 1982 June 23.

4.8 PAN, NITRIC ACID, PARTICULATE NITRATE, AND NITROGEN OXIDES RELATIONSHIPS

A comparison of the amount of nitrogen occurring in the form of PAN, nitric acid, particulate nitrate, and nitrogen oxides is given in Table 14. The values are presented as nitrate equivalents to allow direct comparison among different compounds. The dominant form is as nitrogen oxides, with PAN being the major product of the photochemical conversion of nitrogen oxides during daylight hours. PAN is far more abundant during the day than nitric acid collected on the nylon filters or particulate nitrate collected on the Teflon filter. The implication is that the conversion of nitrogen oxides to nitrate in the Calgary atmosphere proceeds via the PAN intermediate rather than the HNO_3 intermediate. Although the particulate nitrate to HNO_3 ratio varied greatly, from 0.1 to 4, the mean value of 0.51 indicates that nitric acid was generally more abundant than particulate nitrate. The relative concentrations of PAN, nitric acid, and particulate nitrate in the atmosphere will depend upon their rates of formation and degradation or deposition. The amount of non-methane hydrocarbons (NMHC) greatly influences the rate of conversion of NO_x to PAN. In smog chamber experiments (Spicer et al. 1978), low levels of NMHC restricted the initial rate of PAN formation resulting in PAN/HNO_3 ratios of less than 0.5, whereas NMHC/NO_x ratios of 15 or greater gave PAN/HNO_3 ratios of greater than one. Over longer time periods, however, the amount of NMHC had little effect on the ultimate PAN/HNO_3 ratio. More recently, Spicer (1983) has shown the rate of conversion of NO_x to products to be linearly related to the NMHC/NO_x ratio. Ratios of less than 20 are predicted to produce PAN/HNO_3 ratios of less than one. In Calgary, for all the days listed in Table 14, the NMHC/NO_x ratios were greater than 20 and the PAN/HNO_3 ratios were always greater than one. PAN/HNO_3 ratios in Calgary were commonly in the range of 3 to 10, far higher than the 1 to 3 range found by Spicer (1977), and 0.3 to 0.8 reported by Tuazon et al. (1981) for smoggy days in St. Louis and Claremount, California, respectively. The

Table 14. Relative amounts of N occurring as PAN, particulate nitrate, nitric acid, and nitrogen oxides (ug per m^3 of air calculated as NO_3)

DATE	PERIOD	PAN	TEFLON	NYLON	NO_x
82-07-13	0850 to 1300	4.2	0.66	0.52	100
82-07-13	1300 to 1715	3.1	0.10	-	30
82-07-14	0830 to 1330	1.0	0.01	0.40	70
82-07-21	1155 to 1556	1.5	0.83	0.25	60
82-07-23	1153 to 1600	1.8	0.04	0.08	30
82-07-26	0828 to 1205	2.4	0.04	0.04	30
82-07-26	1205 to 1557	1.9	0.11	0.19	30
82-07-27	0838 to 1151	1.9	0.38	0.47	40
82-07-38	0831 to 1153	3.3	0.27	0.12	60
	1154 to 1553	6.0	1.71	0.84	40
82-07-29	0818 to 1153	3.8	1.73	0.50	-
	1154 to 1554	4.8	0.08	0.00	-
82-08-03	0819 to 1152	2.2	0.35	0.50	80
	1153 to 1605	1.6	0.34	0.84	30
82-08-04	0826 to 1153	1.9	0.15	0.25	60
82-08-05	1153 to 1651	2.5	0.36	0.04	30
82-08-17	1019 to 1200	2.8	0.60	0.19	100
82-08-17	1202 to 1558	3.1	0.30	1.57	30

high NMHC/NO_x ratios found in Calgary would facilitate rapid PAN formation and high PAN/HNO_3 ratios. During nighttime hours, PAN was not measurable and both Teflon-filter collected nitrate and nylon filter-collected nitrate decreased from a mean of 0.30 ug/m^3 to 0.10 ug/m^3 and from 0.28 ug/m^3 to 0.11 ug/m^3, respectively. Thus, there was no increase in particulate nitrate in Calgary at night such as was observed by Grosjean (1983) in California. Such an increase would not be expected, however, because the pollutants generated during the day in Calgary are likely to have been transported out of the city at night and have been replaced with clean air.

4.9 MODEL CALCULATIONS

Bottenheim et al. (1977) studied the effect of temperature and solar altitude variation on the chemical processes which take place in a general photochemical air pollution system at 60°N latitude. Eleven photochemical and 100 dark reactions of 11 initial reactants were considered. The assumption of no atmospheric dilution of products and reactants was employed in these computations. Ambient air pollutant concentrations measured at 1100 h and appropriate photochemical rate parameters for Calgary's solar altitudes for August 14 were used in our computations. The calculated O_3/PAN ratio is displayed as a function of time in Figure 18 along with initial pollutant concentrations, temperature, and relative humidity values.

Observed O_3/PAN values for the same day are also shown in Figure 18. Considering the assumptions of no dilution of reactants and products in the model, the trend in the observed ratios is reasonably predicted by the computations. Further work is underway to improve the model in the light of these observations.

4.10 PERSISTENCE AND LONG-RANGE TRANSPORT OF PAN

The long-range transport of acid forming emissions away from major sources is well known and is evidenced by the

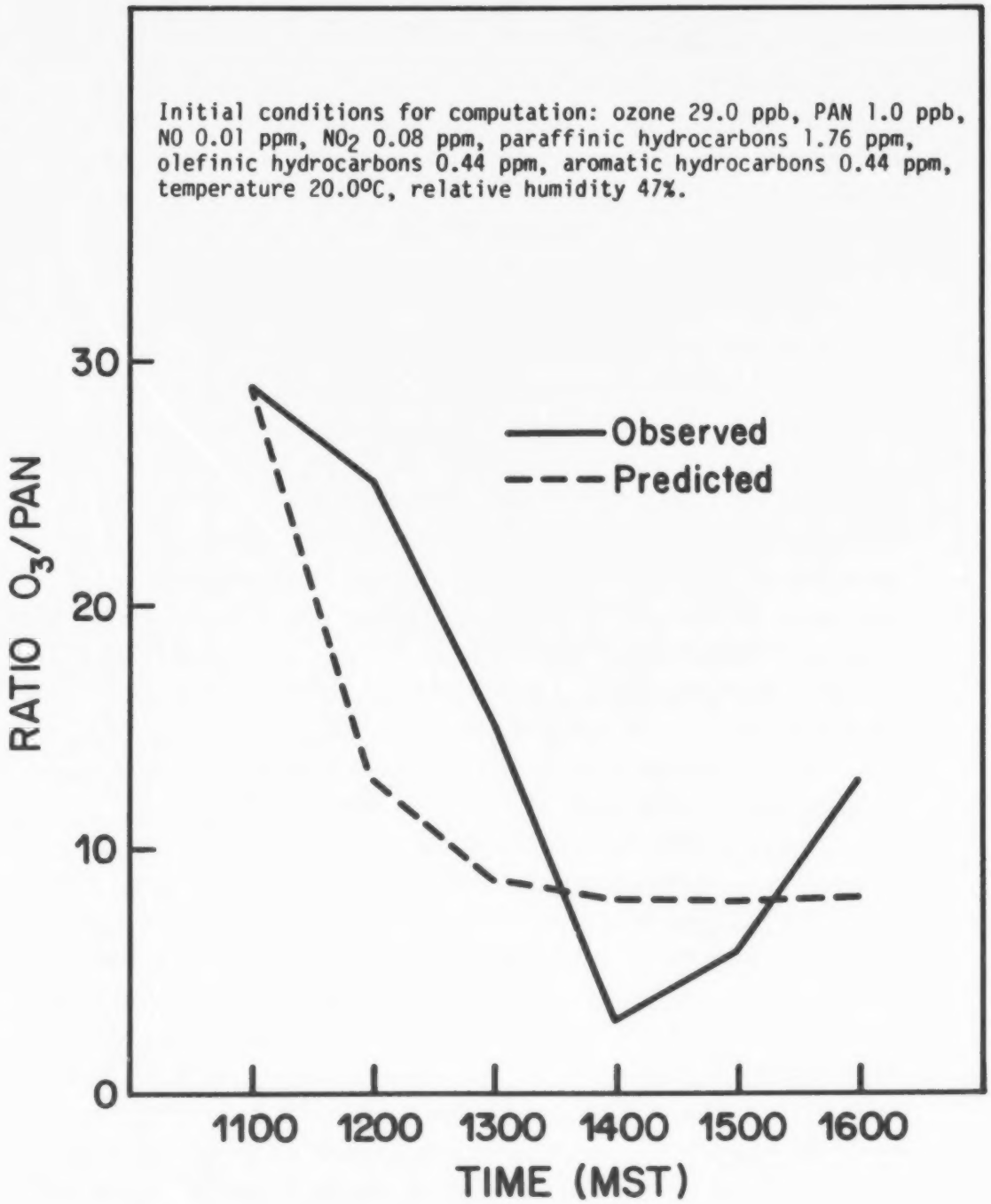

Figure 18. Predicted ozone/PAN ratios and observed ratios for downtown Calgary, 1981 August 14.

ever-increasing numbers of areas in North America which are being subject to rain of low pH. The contribution of nitric acid to the acidity of rain in locations remote from sources of nitrogen compounds is greater than anticipated on the basis of present theory (Bottenheim, Atmospheric Environment Service, Downsview, Ontario; private communication 1983). Nitric acid is depleted from the atmosphere much more rapidly than sulphuric acid and, therefore, the nitric acid to sulphuric acid ratio should decrease quickly with distance from an area source of these compounds. Such a depletion does occur but not as rapidly as expected, and nitric acid contributes a significant part of the acidity of rain even in remote areas.

Peroxyacetyl nitrate may be a means by which nitrogen compounds can be transported great distances. Nitrogen oxides appear to be preferentially converted to PAN rather than nitric acid. PAN is more stable in the atmosphere than nitric acid, and could undergo long-range transport. PAN degrades in the presence of NO to yield NO_2. Upon reaction with NO during daylight hours, NO_2 and alkyl radicals are produced. In the presence of reactive hydrocarbons, these products in turn react to regenerate PAN and produce nitric acid. By this mechanism, nitric acid may be generated far from the source of the emission with PAN being the key transport agent.

The physical form of water vapor in the atmosphere also is important in determining acidity. Recent studies by Hoffman and his associates (Waldman et al. 1982) showed fog to be 100 times more acidic than average rain in areas of southern California subject to urban or industrial pollution (Table 15). Fog water collected by a rotating arm sampler in December of 1982 had a pH as low as 1.69 (Hileman 1983). Studies in the Whiteface Mountain area of the Adirondacks have also shown fog to be far more acidic than rainwater and it is thought that frost and ice fog may have similar low acidities (Wisniewski 1982). The finding of low pH in ice fog may be of importance in Alberta where Edmonton and the oil sands are subject to winter ice fogs.

Table 15. The pH of fog and rainwater in southern California.

Location	Number of Samples	Date	pH Range	H^+	NH_4^+	NO_3^-	$SO_4^=$
Pasadena	4	81-11-15	5.25 to 4.74	5.6 to 55	370	130 to 930	62 to 380
Pasadena	4	81-11-23	4.85 to 2.92	14 to 1200	1290 to 2380	1220 to 3520	481 to 944
Lennox	8	81-12-07	5.78 to 2.55	2 to 2830	1120 to 4060	820 to 4560	540 to 2090
Lennox	3	81-12-17	2.81 to 2.52	1550 to 3020	950 to 1570	2070 to 3690	610 to 1970
Bakersfield	3	82-01-14	3.07 to 2.90	850 to 1260	5370 to 10520	3140 to 5140	2250 to 5000
Pasadena	1	82-01-17	2.25	5625	7870	12000	5060
Los Angeles rain (mean of nine sites)		1978 to 1979	5.4 to 4.4	4 to 39	1 to 36	11 to 44	7 to 56
Coastal California fogs		76-09-10			1 to 578	23 to 234	52 to 490
Whiteface Mountain		80-07 to 08	4.2 to 3.2	63 to 630	4 to 310	7 to 190	40 to 800
Fog and Clouds USSR		1961 to 1964	5.3 to 4.7	5 to 20	33 to 100	2 to 13	13 to 185

If the dual maxima in PAN concentration which occurred in Calgary on 1981 August 10 were the result of air mass movement, the relative concentrations of PAN (4.5 ppb at 1130 h, and 3.0 ppb at 2030 h) are of interest. Additional PAN would be generated from pollutants in the moving air mass downwind from Calgary but this would be opposed by the destruction of PAN by chemical reactions in the atmosphere and at the surface. There would also be some mixing of the air mass and dilution of PAN. The net rate of change in PAN concentration over this nine hour period was 33%.

Decay rates for PAN and ozone have been measured over grass, soil, and water. Deposition velocities of PAN over grass and soil were similar (0.21 and 0.26 cm/s) but were considerably lower over water (0.02 cm/s) (Penkett et al. 1977; Garland and Penkett 1976). These rates indicate that surface chemical reaction is the major mechanism of PAN removal from the atmosphere rather than gas-phase reactions with other pollutants such as nitric oxide (Garland and Penkett 1976). Surface reactions are also believed to be responsible for the daily cycle in atmospheric ozone concentrations (Garland and Derwent 1979). The deposition velocity of ozone is about three times greater than that of PAN over grass and about six times greater over soil. Thus, PAN is more persistent in the atmosphere than ozone. Although PAN in the Calgary atmosphere generally decreased rapidly in concentration during the late afternoon, it would sometimes persist overnight. It should be emphasized that a decline in PAN concentration may not mean that the PAN was degraded; it may simply mean that an unpolluted air mass has replaced the polluted air, or that the mixing height has increased. In the Los Angeles basin, where very large polluted air masses may be expected, PAN averaged 17.7 ppb over one 18-day period with readings as high as 26 ppb at midnight (Temple and Taylor 1983).

On several days, the maximum PAN concentrations in Calgary occurred after a change in wind direction which may have signaled the breakup of the temperature inversion (Figures 4, 6, 7, and 9). Should the breakup of the nocturnal temperature inversion have

preceeded the occurrence of the PAN maximum, the thesis that PAN degrades primarily by contact with surfaces would be supported (Brasser et al. 1977). Presumably, PAN would persist above the thermal inversion whereas the PAN below the temperature inversion would be degraded. At the breakup of the inversion, air containing higher concentrations of PAN would be brought to ground level.

The origin of the unexpectedly high PAN concentrations in the Kananaskis Valley is of interest. PAN could be generated locally or have been transported to Kananaskis. Recent studies in northern Sweden (56-58°N) have shown transport of PAN for about 1000 km in air masses moving mainly over the sea (Nielsen et al. 1981). The source of PAN in southern Scandinavia is probably Great Britain or the central continent. PAN is more stable over water than over land and the sources of pollutants in industrialized Great Britain and Europe are large. In contrast, there are no large sources of pollutants on the North American continent to the northwest of Calgary and sources to the west and southwest are small in comparison with those of Europe. If Vancouver or Seattle, the only major cities to the west, were the source, PAN or its precursors would be transported 650 km over land before reaching the Kananaskis sampling site. Deposition velocities of PAN are about 10 times greater over land than over water (Garland and Penkett 1976). For PAN to reach the Kananaskis site, it must be transported at such an altitude that there is no easy contact with the ground. To the west of Calgary are five mountain ranges with peaks up to 3800 m high. On the eastern edge of the mountains, air from higher altitudes sweeps down to the plains. In this zone, PAN, which may have been transported thousands of kilometres or perhaps existed in the upper atmosphere naturally or as a result of anthropogenic pollutants, may be brought to ground level. The Kananaskis sampling site located on the eastern slopes of the Rocky Mountains may be in a position to intercept and monitor this air. This could account for low concentrations of PAN recorded at Kananaskis; it would not account for the high concentrations occasionally recorded.

Since the peak PAN concentrations at Kananaskis often occurred late in the day rather than during the afternoon when solar radiation intensity was highest, it is believed that the majority of the PAN was not generated locally. As discussed in the meteorological report (Appendix 9.5), pollutants can move toward Kananaskis from Calgary when light winds from the East prevail. However, the 2.2 and 2.3 ppb PAN found on 1982 June 19 and June 23 at Kananaskis were equivalent to the highest concentrations found in a west Calgary residential area over a nine month period in 1981. If the Calgary pollutant plume were considered initially to be 5 km wide with an initial standard deviation of 1.2 km, the model of Davison and Leavitt (1979) suggests that dispersion alone would reduce the concentration of pollutants to less than one-half before they reached Kananaskis. Therefore, it appears unlikely that Calgary was the source of PAN.

During the summer of 1982, large forest fires burned continuously for several weeks in northern Alberta and, on occasion, dense smoke was transported to southern Alberta. Forest fire smoke was observed at Kananaskis on June 19 and June 23. Similarly, smoke was recorded in Calgary on July 28 and July 29 and high PAN values of 3.0 and 3.5 ppb were measured in west Calgary (Appendix 9.8). Air mass trajectory analysis for June 23 showed that air monitored in Kananaskis on that date originated the previous day in the vicinity of the forest fires. It is believed that forest fire smoke was the main source of PAN recorded June 19 and 23 at Kananaskis, and July 28 and 29 west in Calgary. This conclusion is consistent with the finding of above ambient levels of ozone and nitrogen oxide in forest fire smoke (Evans et al. 1974, 1977; Stith 1981).

5. BIOLOGICAL EFFECTS

Peroxyacetyl nitrate is the most phytotoxic of the known photochemical oxidants (National Research Council 1977). It reacts with the sulphydryl groups in enzymes, inhibiting cyclic photosynthetic phosphorylation (Dugger and Ting 1970; Mudd 1963, 1966; Mudd et al. 1966). Compounds such as coenzyme A, lipoic acid, and cystein are oxidized, whereas alcohols and amines are acetylated (Nicksic et al. 1967; Wendschuh et al. 1973). Illumination is required before any symptoms of damage are observed, with maximum effect at wavelengths of 420-480 nm indicating that carotenoid and flavin pigments in the leaf cells are affected (Dugger et al. 1963).

Concentrations of PAN of 15 to 20 ppb with an exposure time of four hours causes injury to sensitive species such as pinto beans and oats (Linzon et al. 1975; Taylor 1969). Within two to three hours after exposure of susceptible species to PAN, the lower leaf surface develops an oily or waxy appearance which changes to a bronzed area in two or three days (Taylor and MacLean 1970). These symptoms are caused by collapse of the protoplast of the mesophyll cells in the region of the stomata, giving rise to air pockets and drying out of the epidermia. The above symptoms are the result of light-to-moderate exposure and are visible only on the lower leaf surface (Taylor et al. 1974); by contrast, ozone produces chlorotic mottling or flecking on the upper surface (Heggestad 1971; Hill et al. 1972; Linzon et al. 1975).

Acute PAN injury seldom develops in the leaves of woody shrubs and trees but succulent ornamentals, grasses, and vegetables are severely injured (Taylor 1973). The injury to monocatyledons appears as a distinct traverse leaf band (Taylor and MacLean 1970; Heggestad 1971). Concentrations of PAN in Alberta at present are too low to produce the above injury. A more complete review of the effects of PAN on plants is to be found in a previous report to Alberta Environment, "The oxides of nitrogen and their interactions in the environment: a review" (Legge et al. 1980).

Peroxyacetyl nitrate is a strong eye irritant (Mudd 1975; Stephens et al. 1960) and has been suggested as a possible cause of skin cancer (Lovelock 1977). Symptoms of eye irritation appear at concentrations of 150 to 200 ppb. PAN occurs with other peroxyacyl-nitrates such as peroxypropionyl nitrate and peroxybenzyl nitrate which are biologically more active. Peroxybenzyl nitrate is 200 times more active as an eye irritant than formaldehyde (National Research Council 1977). Exposure of healthy men to 300 ppb PAN leads not only to eye irritation but also causes an increase in oxygen uptake especially during exercise (Ferris 1978).

The low concentrations of PAN and its analogues presently found in the Calgary atmosphere are not likely to present a health hazard except possibly to highly allergic individuals.

6. SUMMARY AND CONCLUSIONS

1. Peroxyacetyl nitrate (PAN) was sampled every 30 minutes from 1981 July 12 to 1982 February 28 at a downtown Calgary location ($51^{o}N$) and analyzed by electron capture gas chromatography. In addition, PAN was sampled and analysed during working days, from 0700 to 1500 MST at the University of Calgary, 6 km northwest of the downtown site, from 1980 December 01 to 1981 August 31.

2. The highest concentrations of PAN recorded were 6.6 ppb in downtown Calgary and 2.4 ppb at the University of Calgary, both values occurring simultaneously on 1981 August 14. Mean concentrations of PAN were 0.14 ppb measured on a 24-hour basis in downtown Calgary and 0.22 ppb measured on a daytime basis only at the university. These concentrations are lower than found in the Los Angeles basin where PAN concentrations of up to 65 ppb have been reported but are in the same range as most North American and European cities.

3. Concentrations of peroxyacetyl nitrate in Calgary usually increased rapidly in response to early morning emissions of primary pollutants and increasing intensity of solar radiation. The maximum in both PAN and ozone concentrations was usually reached between 1200 and 1300 MST each day. Concentrations of PAN and ozone then decreased as the NO to NO_2 ratio declined. On occasion, PAN would persist through the night and a second peak in concentration would occur at night, probably as a result of air movement along the river valley in response to adiabatic heating and cooling. The mean daily maximum concentration was 0.59 ppb in downtown Calgary and 0.38 ppb at the University of Calgary.

4. The concentrations of PAN in Calgary are limited in the winter time by the low intensity and short duration of solar radiation, and in the summer by relatively low concentrations of NO_x in the atmosphere.

5. Under conditions of high concentrations of pollutants during the winter, PAN can be formed at temperatures below 0^oC.

6. Ozone:PAN ratios as low as 1:1 were recorded during days with high concentrations of nitrogen oxides, but ratios of 10 to 35:1 were more common in downtown Calgary, and 35 to 100:1 were more common at the university.

7. Mean concentrations of PAN measured in the Kananaskis Valley in the Rocky Mountains, 70 km west of Calgary, were low (0.10 ppb). On occasion, much higher values of up to 2.3 ppb were recorded. These high values coincided with the arrival of forest fire smoke from northern Alberta, indicating that significant natural source of PAN exist in addition to anthropogenic sources.

8. Mean nitrate and sulphate concentrations in the Calgary atmosphere are low in comparison with values reported for major North American cities. Mean nitrate values of 3.5 ug/m^3 and 7.8 ug/m^3 sulphate were found using high volume sampling techniques. High concentrations (up to 29 ug/m^3 nitrate and 41 ug/m^3 sulphate) were measured during transitory events.

9. PAN:nitric acid:particulate nitrate ratios indicate that PAN is the major reaction product of nitrogen oxides in the atmosphere. The decomposition of PAN may initiate the generation of

nitric acid; thus, PAN may be an important agent in the long-range transport of acidic pollutants.

10. Particulate nitrate and volatile nitrate (nitric acid) concentrations as determined by low volume sampling techniques were also low. Mean concentrations at the University of Calgary were 0.25 ug/m^3 particulate nitrate, and 0.26 ug/m^3 nitric acid. The highest total nitrate value recorded was 6.2 ug/m^3. In the Kananaskis Valley, the mean total nitrate value was 0.35 ug/m^3 of which 0.13 ug/m^3 was particulate nitrate and 0.22 ug/m^3 volatile nitrate.

11. Present concentrations of PAN in Calgary are well below those previously reported to injure plants or present health problems except possibly to some highly susceptible individuals.

7. RECOMMENDATIONS

1. In view of the high concentrations of oxides of nitrogen found in the atmospheres of both Calgary and Edmonton, it is recommended that further research into the chemistry and environmental effects of these pollutants be undertaken.

2. It is recommended that ambient atmospheric concentrations of PAN, nitric acid, and particulate nitrate be monitored in the Edmonton atmosphere (ideally at the same time as in Calgary) to determine present concentrations of these pollutants and to provide a means of measuring future changes in air quality.

3. In view of the role of hydrocarbons (HC) in the formation of PAN, it is recommended that HC in the atmosphere of Calgary and Edmonton be characterized and quantified, and that the sources of NO_x, SO_x, and HC in both cities be further quantified.

4. It is recommended that meteorological studies be an integral part of any further studies of pollutant concentrations and chemistry.

5. It is recommended that existing data be used to test mathematical models of the atmospheric chemistry of air pollutants and of air pollution transport. It is further recommended that future measurements of atmospheric pollutants be made specifically to test existing mathematical models.

6. In view of the suspected role of PAN in the long-range transport of acid forming pollutants, it is recommended that monitoring of background concentrations of PAN, nitric acid, particulate nitrate,and nitrogen oxides be continued in the Kananaskis Valley,

and that similar monitoring stations be established in other areas of the province.

7. In view of the low pH of fogs elsewhere, it is recommended that a study of the chemistry of clouds and ice fogs in Alberta be carried out in conjunction with studies of the physics of cloud and ice fog formation.

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9. APPENDICES

9.1 CONCENTRATIONS OF PAN IN THE AMBIENT ATMOSPHERE IN DOWNTOWN CALGARY, 1981 JULY TO 1982 FEBRUARY

Table 16. PAN concentrations in downtown Calgary, 1981 July.

Day	9	10	11	12	13	14	15	16
Time								
00:30	-	-	-	-	-	-	-	-
01:00	-	-	-	-	-	-	-	-
01:30	-	-	-	-	-	-	-	-
02:00	-	-	-	-	-	-	-	-
02:30	-	-	-	-	-	-	-	-
03:00	-	-	-	-	-	-	-	-
03:30	-	-	-	-	-	-	-	-
04:00	-	-	-	-	-	-	-	-
04:30	-	-	-	-	-	-	-	-
05:00	-	-	-	-	-	-	-	-
05:30	-	-	-	-	-	-	-	-
06:00	-	-	-	-	-	-	-	-
06:30	-	-	-	-	-	-	-	-
07:00	-	-	-	-	-	-	-	-
07:30	-	-	-	-	-	-	-	-
08:00	-	-	-	-	-	-	-	-
08:30	-	-	-	-	-	-	-	-
09:00	-	-	-	-	-	-	-	-
09:30	-	-	-	-	-	-	-	-
10:00	-	-	-	-	-	-	-	-
10:30	-	-	-	-	-	-	-	-
11:00	-	-	-	-	-	-	-	0.40
11:30	-	-	-	-	-	-	-	-
12:00	-	-	-	-	-	-	-	0.36
12:30	-	-	-	-	-	-	-	-
13:00	-	-	-	-	-	-	-	0.51
13:30	-	-	-	-	-	-	-	-
14:00	-	-	-	-	-	-	-	0.52
14:30	-	-	-	-	-	-	-	-
15:00	-	-	-	-	-	-	-	-
15:30	-	-	-	-	-	-	-	-
16:00	-	-	-	-	-	-	-	0.56
16:30	-	-	-	-	-	-	-	-
17:00	-	-	-	-	-	-	-	-
17:30	-	-	-	-	-	-	-	-
18:00	-	-	-	-	-	-	-	-
18:30	-	-	-	-	-	-	-	-
19:00	-	-	-	-	-	-	-	-
19:30	-	-	-	-	-	-	-	-
20:00	-	-	-	-	-	-	-	-
20:30	-	-	-	-	-	-	-	-
21:00	-	-	-	-	-	-	-	-
21:30	-	-	-	-	-	-	-	-
22:00	-	-	-	-	-	-	-	-
22:30	-	-	-	-	-	-	-	-
23:00	-	-	-	-	-	-	-	-
23:30	-	-	-	-	-	-	-	-
24:00	-	-	-	-	-	-	-	-

continued...

Table 16. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	-	-	-	-	-	<0.20	<0.20	<0.20
01:00	0.38	-	-	-	-	<0.20	<0.20	<0.20
01:30	-	-	-	-	-	<0.20	<0.20	<0.20
02:00	0.36	-	-	-	-	<0.20	<0.20	<0.20
02:30	-	-	-	-	-	<0.20	<0.20	<0.20
03:00	<0.20	-	-	-	-	<0.20	<0.20	<0.20
03:30	-	-	-	-	-	<0.20	<0.20	<0.20
04:00	<0.20	-	-	-	-	<0.20	<0.20	<0.20
04:30	-	-	-	-	-	<0.20	<0.20	<0.20
05:00	<0.20	-	-	-	-	<0.20	<0.20	<0.20
05:30	-	-	-	-	-	<0.20	<0.20	<0.20
06:00	<0.20	-	-	-	-	<0.20	<0.20	<0.20
06:30	-	-	-	-	-	<0.20	<0.20	<0.20
07:00	<0.20	-	-	-	-	<0.20	<0.20	<0.20
07:30	-	-	-	-	-	<0.20	<0.20	<0.20
08:00	-	-	-	-	-	<0.20	<0.20	<0.20
08:30	-	-	-	-	-	<0.20	<0.20	<0.20
09:00	-	-	-	-	-	<0.20	<0.20	-
09:30	-	-	-	-	-	<0.20	<0.20	-
10:00	-	-	-	-	-	<0.20	-	-
10:30	-	-	-	-	<0.20	<0.20	-	-
11:00	-	-	-	-	<0.20	-	-	-
11:30	-	-	-	-	<0.20	-	-	-
12:00	-	-	-	-	0.38	-	-	-
12:30	-	-	-	-	<0.20	-	-	-
13:00	-	-	-	-	<0.20	-	-	-
13:30	-	-	-	-	<0.20	-	-	-
14:00	-	-	-	-	<0.20	-	-	-
14:30	-	-	-	-	<0.20	-	-	-
15:00	-	-	-	-	<0.20	-	-	-
15:30	-	-	-	-	<0.20	-	-	-
16:00	-	-	-	-	0.44	-	0.44	-
16:30	-	-	-	-	<0.20	-	0.44	-
17:00	-	-	-	-	<0.20	<0.20	<0.20	-
17:30	-	-	-	-	<0.20	<0.20	<0.20	-
18:00	-	-	-	-	<0.20	<0.20	<0.20	-
18:30	-	-	-	-	<0.20	<0.20	<0.20	-
19:00	-	-	-	-	<0.20	<0.20	<0.20	-
19:30	-	-	-	-	<0.20	<0.20	<0.20	-
20:00	-	-	-	-	<0.20	<0.20	<0.20	-
20:30	-	-	-	-	<0.20	<0.20	<0.20	-
21:00	-	-	-	-	<0.20	<0.20	<0.20	-
21:30	-	-	-	-	<0.20	<0.20	<0.20	-
22:00	-	-	-	-	<0.20	<0.20	<0.20	-
22:30	-	-	-	-	<0.20	<0.20	<0.20	-
23:00	-	-	-	-	<0.20	<0.20	<0.20	-
23:30	-	-	-	-	<0.20	<0.20	<0.20	-
24:00	-	-	-	-	<0.20	<0.20	<0.20	-

continued...

Table 16. Concluded.

Day	25	26	27	28	29	30	31
Time							
00:30	-	-	-	<0.20	<0.20	<0.20	<0.20
01:00	-	-	-	<0.20	<0.20	<0.20	<0.20
01:30	-	-	-	<0.20	<0.20	<0.20	0.45
02:00	-	-	-	<0.20	<0.20	<0.20	<0.20
02:30	-	-	-	<0.20	0.43	<0.20	<0.20
03:00	-	-	-	<0.20	<0.20	<0.20	<0.20
03:30	-	-	-	<0.20	<0.20	<0.20	<0.20
04:00	-	-	-	<0.20	<0.20	<0.20	<0.20
04:30	-	-	-	<0.20	<0.20	<0.20	<0.20
05:00	-	-	-	<0.20	<0.20	<0.20	<0.20
05:30	-	-	-	<0.20	<0.20	<0.20	<0.20
06:00	-	-	-	<0.20	<0.20	<0.20	<0.20
06:30	-	-	-	<0.20	<0.20	<0.20	<0.20
07:00	-	-	-	<0.20	<0.20	<0.20	<0.20
07:30	-	-	-	<0.20	<0.20	<0.20	<0.20
08:00	-	-	-	<0.20	<0.20	<0.20	<0.20
08:30	-	-	-	<0.20	<0.20	<0.20	<0.20
09:00	-	-	<0.20	<0.20	0.45	<0.20	1.16
09:30	-	-	<0.20	<0.20	0.56	<0.20	1.15
10:00	-	-	<0.20	<0.20	0.45	<0.20	1.16
10:30	-	-	<0.20	<0.20	0.56	<0.20	0.88
11:00	-	-	<0.20	<0.20	0.54	<0.20	0.66
11:30	-	-	<0.20	<0.20	0.60	<0.20	0.46
12:00	-	-	<0.20	0.55	0.87	<0.20	0.64
12:30	-	-	<0.20	0.65	1.16	<0.20	0.92
13:00	-	-	0.66	0.69	1.46	<0.20	0.78
13:30	-	-	0.97	0.83	2.07	<0.20	0.62
14:00	-	-	1.06	0.94	2.27	<0.20	<0.20
14:30	-	-	1.33	0.99	2.94	<0.20	<0.20
15:00	-	-	2.87	1.08	3.15	<0.20	<0.20
15:30	-	-	2.08	0.92	3.36	<0.20	<0.20
16:00	-	-	1.59	0.94	3.68	0.45	<0.20
16:30	-	-	1.03	0.73	2.01	<0.20	<0.20
17:00	-	-	0.95	0.68	<0.20	0.42	<0.20
17:30	-	-	0.75	0.54	<0.20	<0.20	<0.20
18:00	-	-	0.89	0.46	<0.20	0.46	<0.20
18:30	-	-	0.54	<0.20	<0.20	<0.20	<0.20
19:00	-	-	<0.20	0.45	<0.20	<0.20	0.80
19:30	-	-	<0.20	0.52	<0.20	<0.20	0.42
20:00	-	-	<0.20	0.50	<0.20	<0.20	<0.20
20:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	-	-	<0.20	0.41	<0.20	0.55	<0.20
21:30	-	-	<0.20	0.44	<0.20	0.53	<0.20
22:00	-	-	<0.20	<0.20	<0.20	0.46	<0.20
22:30	-	-	<0.20	0.39	<0.20	0.48	<0.20
23:00	-	-	<0.20	<0.20	<0.20	0.43	<0.20
23:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20

Table 17. PAN concentrations in downtown Calgary, 1981 August.

Day	1	2	3	4	5	6	7	8
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	0.46	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	-	-	-	<0.20
10:30	<0.20	0.51	<0.20	<0.20	-	-	-	0.91
11:00	<0.20	0.67	-	<0.20	-	0.69	-	-
11:30	0.47	0.84	0.53	<0.20	-	0.78	-	0.94
12:00	0.51	0.80	0.53	<0.20	-	0.84	-	1.92
12:30	0.50	1.06	0.53	<0.20	-	1.49	-	2.07
13:00	<0.20	1.12	0.51	<0.20	-	2.58	-	2.63
13:30	0.34	1.09	0.55	<0.20	-	2.97	-	2.71
14:00	0.64	1.25	0.49	<0.20	-	2.88	-	2.98
14:30	0.71	1.23	0.57	<0.20	-	3.31	-	2.78
15:00	0.94	1.23	0.57	<0.20	4.57	1.80	-	2.43
15:30	1.01	1.23	0.67	<0.20	5.03	1.99	-	3.30
16:00	0.93	0.82	<0.20	<0.20	3.99	1.79	-	<0.20
16:30	0.82	0.74	<0.20	<0.20	2.88	1.15	1.14	3.41
17:00	0.72	0.67	<0.20	0.48	2.50	1.08	0.79	3.07
17:30	<0.20	0.76	<0.20	0.48	2.27	0.64	0.87	2.31
18:00	<0.20	0.76	<0.20	<0.20	1.67	0.46	0.67	1.85
18:30	<0.20	0.80	<0.20	<0.20	1.74	0.50	0.73	1.50
19:00	0.42	0.65	0.39	<0.20	1.70	<0.20	0.80	1.32
19:30	0.43	0.64	<0.20	<0.20	1.70	<0.20	0.72	1.11
20:00	0.48	0.62	<0.20	<0.20	2.25	<0.20	0.52	0.71
20:30	0.45	0.69	<0.20	<0.20	1.98	<0.20	0.62	0.65
21:00	<0.20	0.62	<0.20	<0.20	2.33	<0.20	0.76	0.70
21:30	0.46	0.61	0.44	0.44	2.39	<0.20	0.67	0.87
22:00	<0.20	0.56	<0.20	0.44	1.77	0.49	0.64	0.71
22:30	<0.20	0.93	<0.20	<0.20	1.26	<0.20	0.58	0.56
23:00	<0.20	0.51	<0.20	<0.20	<0.20	0.57	0.57	0.72
23:30	0.48	<0.20	<0.20	<0.20	<0.20	<0.20	0.56	0.49
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.51	0.48

continued...

Table 17. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	<0.20	0.74	<0.20	1.16	-	-	<0.20
01:00	0.77	<0.20	0.90	<0.20	1.25	-	-	<0.20
01:30	0.98	<0.20	0.74	<0.20	1.33	-	-	<0.20
02:00	1.27	<0.20	0.90	<0.20	-	-	-	-
02:30	1.04	<0.20	1.13	<0.20	1.30	-	-	-
03:00	1.03	<0.20	1.13	<0.20	1.38	-	-	-
03:30	0.88	<0.20	0.92	<0.20	1.50	-	-	-
04:00	0.91	<0.20	0.81	<0.20	1.15	-	-	-
04:30	0.79	<0.20	0.63	<0.20	1.03	-	-	-
05:00	0.80	<0.20	<0.20	<0.20	0.82	-	-	-
05:30	0.74	<0.20	<0.20	<0.20	0.94	-	-	-
06:00	0.64	<0.20	<0.20	<0.20	-	-	-	-
06:30	0.52	<0.20	<0.20	<0.20	-	-	-	-
07:00	0.56	<0.20	<0.20	<0.20	-	-	-	-
07:30	0.54	<0.20	<0.20	<0.20	0.53	-	-	-
08:00	0.48	<0.20	<0.20	<0.20	-	-	-	-
08:30	<0.20	<0.20	<0.20	<0.20	1.11	-	-	-
09:00	0.45	<0.20	<0.20	<0.20	-	-	-	-
09:30	0.46	<0.20	<0.20	<0.20	1.35	0.50	-	-
10:00	0.70	-	<0.20	<0.20	-	0.57	-	-
10:30	1.10	-	0.66	0.46	-	0.82	-	-
11:00	1.36	-	0.55	0.58	-	0.89	-	-
11:30	1.16	-	0.88	0.68	-	0.78	-	-
12:00	1.06	1.16	1.47	0.94	-	1.12	-	-
12:30	0.91	1.61	2.09	0.56	-	1.18	-	-
13:00	0.84	2.36	3.72	0.84	-	1.28	-	-
13:30	0.53	1.53	3.36	0.42	-	2.17	-	-
14:00	<0.20	-	2.20	0.56	-	2.95	-	-
14:30	<0.20	4.50	1.42	0.71	-	6.55	-	-
15:00	<0.20	4.30	1.19	0.54	-	5.31	-	-
15:30	<0.20	0.70	0.97	0.58	-	3.13	-	-
16:00	0.49	0.49	1.90	<0.20	-	2.38	-	-
16:30	<0.20	0.58	1.60	<0.20	-	2.24	-	-
17:00	<0.20	0.47	1.43	0.60	-	1.29	<0.20	-
17:30	<0.20	1.35	1.14	0.79	-	0.76	-	-
18:00	<0.20	1.08	1.04	0.96	-	0.80	-	-
18:30	<0.20	0.99	0.83	0.61	-	0.61	-	-
19:00	<0.20	0.82	0.62	0.87	-	0.81	-	-
19:30	<0.20	0.76	0.53	0.75	-	0.81	-	-
20:00	<0.20	0.76	0.67	0.71	-	0.80	-	-
20:30	<0.20	1.44	0.65	0.83	-	0.90	-	<0.20
21:00	<0.20	2.10	0.53	1.35	-	1.05	-	-
21:30	<0.20	3.02	0.70	1.46	-	0.99	-	-
22:00	<0.20	1.76	0.71	1.17	-	0.60	-	-
22:30	<0.20	1.03	0.66	1.26	-	-	-	-
23:00	<0.20	1.13	0.66	1.16	-	0.46	-	-
23:30	<0.20	0.80	0.54	1.15	-	-	-	-
24:00	<0.20	0.74	0.51	1.19	-	-	-	-

continued...

Table 17. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	-	<0.20	0.46	<0.20	<0.20	1.16	-	-
01:00	-	<0.20	0.47	<0.20	<0.20	0.60	<0.20	<0.20
01:30	<0.20	<0.20	-	-	<0.20	0.62	<0.20	<0.20
02:00	-	<0.20	-	-	<0.20	0.74	<0.20	<0.20
02:30	<0.20	-	-	-	<0.20	0.72	<0.20	<0.20
03:00	-	<0.20	-	<0.20	<0.20	0.70	<0.20	<0.20
03:30	-	<0.20	-	<0.20	<0.20	0.55	<0.20	<0.20
04:00	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	-	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	-	-	<0.20	<0.20	0.45	<0.20	0.43
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.56	0.99	0.50
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.55	0.64	0.56
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.92	0.68	0.63
12:00	<0.20	0.85	-	<0.20	0.53	1.09	0.62	0.86
12:30	0.44	-	<0.20	<0.20	0.59	0.96	0.81	0.96
13:00	0.64	-	<0.20	<0.20	<0.20	0.77	0.72	0.87
13:30	1.30	-	<0.20	<0.20	0.52	0.74	<0.20	0.80
14:00	1.33	-	<0.20	<0.20	0.60	0.64	0.47	0.70
14:30	0.87	-	<0.20	<0.20	0.56	0.57	<0.20	0.83
15:00	1.15	-	<0.20	<0.20	0.71	0.57	<0.20	0.52
15:30	<0.20	-	<0.20	<0.20	0.74	0.56	<0.20	<0.20
16:00	<0.20	-	<0.20	0.53	0.97	<0.20	<0.20	<0.20
16:30	<0.20	-	<0.20	<0.20	1.26	<0.20	<0.20	<0.20
17:00	<0.20	-	<0.20	0.44	1.13	<0.20	<0.20	<0.20
17:30	<0.20	-	<0.20	0.43	1.20	0.47	<0.20	<0.20
18:00	<0.20	-	<0.20	0.50	1.45	<0.20	<0.20	<0.20
18:30	<0.20	-	<0.20	0.62	2.66	<0.20	<0.20	<0.20
19:00	<0.20	-	<0.20	0.59	2.39	<0.20	<0.20	<0.20
19:30	<0.20	-	<0.20	0.58	1.70	<0.20	<0.20	<0.20
20:00	<0.20	-	<0.20	0.45	1.63	<0.20	0.53	<0.20
20:30	-	<0.20	<0.20	<0.20	1.31	<0.20	0.47	<0.20
21:00	<0.20	-	<0.20	0.94	1.01	<0.20	0.47	<0.20
21:30	<0.20	-	<0.20	0.65	0.86	<0.20	0.45	<0.20
22:00	<0.20	-	<0.20	0.62	0.75	<0.20	0.50	<0.20
22:30	<0.20	-	<0.20	0.51	0.70	<0.20	<0.20	<0.20
23:00	<0.20	-	<0.20	0.42	0.47	<0.20	<0.20	<0.20
23:30	<0.20	-	<0.20	0.43	0.45	<0.20	<0.20	<0.20
24:00	<0.20	-	<0.20	<0.20	0.49	<0.20	<0.20	<0.20

continued...

Table 17. Continued.

Day	25	26	27	28	29	30	31
Time							
00:30	<0.20	-	<0.20	0.46	<0.20	0.46	0.46
01:00	<0.20	<0.20	<0.20	0.75	<0.20	1.34	0.47
01:30	<0.20	<0.20	<0.20	0.98	<0.20	1.29	0.41
02:00	<0.20	<0.20	<0.20	0.93	<0.20	1.24	<0.20
02:30	<0.20	<0.20	<0.20	1.18	<0.20	1.14	<0.20
03:00	<0.20	<0.20	<0.20	1.31	<0.20	1.12	<0.20
03:30	<0.20	<0.20	<0.20	1.29	<0.20	1.08	<0.20
04:00	<0.20	<0.20	<0.20	1.24	<0.20	1.07	<0.20
04:30	<0.20	<0.20	1.11	<0.20	1.05	1.05	<0.20
05:00	<0.20	<0.20	<0.20	1.11	<0.20	1.00	<0.20
05:30	<0.20	<0.20	<0.20	0.87	<0.20	0.96	<0.20
06:00	<0.20	<0.20	0.68	<0.20	0.86	<0.20	<0.20
06:30	<0.20	<0.20	0.53	1.15	0.91	0.91	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	1.12	0.79	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	0.87	0.66	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	0.48	0.45	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	0.91	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	0.74	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	0.89	<0.20	<0.20
10:00	<0.20	<0.20	0.51	<0.20	1.06	<0.20	<0.20
10:30	<0.20	0.44	<0.20	<0.20	1.15	<0.20	<0.20
11:00	<0.20	0.52	0.60	<0.20	1.30	<0.20	<0.20
11:30	0.66	0.79	0.69	<0.20	1.28	<0.20	<0.20
12:00	0.74	0.76	0.50	1.45	<0.20	<0.20	<0.20
12:30	0.78	1.27	0.63	1.53	<0.20	<0.20	<0.20
13:00	0.69	<0.20	1.29	0.83	1.41	<0.20	<0.20
13:30	0.48	<0.20	1.67	1.09	0.83	<0.20	<0.20
14:00	<0.20	<0.20	3.81	0.90	0.80	<0.20	0.43
14:30	<0.20	<0.20	4.60	1.32	0.87	<0.20	0.47
15:00	<0.20	<0.20	2.67	1.46	0.93	0.64	0.52
15:30	<0.20	<0.20	2.72	1.74	1.15	0.69	0.60
16:00	<0.20	<0.20	2.58	2.10	1.23	<0.20	0.70
16:30	<0.20	<0.20	2.54	2.00	1.40	0.88	0.95
17:00	<0.20	<0.20	2.47	2.19	1.50	<0.20	0.97
17:30	<0.20	<0.20	2.56	2.26	1.69	<0.20	<0.20
18:00	<0.20	<0.20	1.85	2.30	1.79	<0.20	<0.20
18:30	<0.20	<0.20	1.35	2.36	2.13	<0.20	<0.20
19:00	<0.20	<0.20	1.12	1.94	1.91	<0.20	0.57
19:30	<0.20	0.55	0.79	1.71	2.24	<0.20	0.51
20:00	<0.20	0.80	0.85	1.69	2.43	<0.20	<0.20
20:30	<0.20	0.88	0.57	1.65	2.71	<0.20	<0.20
21:00	<0.20	0.53	0.76	1.56	2.09	<0.20	0.46
21:30	<0.20	<0.20	0.64	1.49	1.97	<0.20	0.45
22:00	<0.20	<0.20	0.59	0.93	1.92	<0.20	<0.20
22:30	<0.20	<0.20	0.46	0.86	1.61	<0.20	<0.20
23:00	<0.20	0.66	0.69	1.34	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	0.55	1.40	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	0.47	1.37	<0.20	<0.20

Table 18. PAN concentrations in downtown Calgary, 1981 September.

Day	1	2	3	4	5	6	7	8
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	0.31	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	0.33	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	0.38	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	0.36	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	0.50	-	<0.20	<0.20	<0.20	<0.20
11:30	0.97	<0.20	0.58	-	0.61	<0.20	0.44	<0.20
12:00	<0.20	<0.20	0.69	-	0.66	<0.20	0.77	<0.20
12:30	<0.20	<0.20	0.69	-	0.71	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	0.69	-	1.08	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	0.79	-	1.07	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	0.80	-	0.93	<0.20	0.49	<0.20
14:30	0.53	<0.20	0.75	-	0.75	<0.20	0.41	0.48
15:00	<0.20	<0.20	0.77	-	0.59	<0.20	<0.20	0.54
15:30	<0.20	<0.20	0.68	-	0.58	0.35	<0.20	0.79
16:00	<0.20	<0.20	0.63	-	0.74	0.34	<0.20	1.76
16:30	<0.20	<0.20	0.52	-	0.79	0.45	<0.20	2.72
17:00	<0.20	0.28	<0.20	-	0.61	<0.20	<0.20	2.42
17:30	<0.20	0.32	<0.20	-	0.49	0.37	<0.20	2.12
18:00	<0.20	<0.20	<0.20	-	0.50	0.80	<0.20	1.53
18:30	<0.20	<0.20	<0.20	-	0.45	0.69	<0.20	1.96
19:00	<0.20	<0.20	<0.20	-	0.42	0.71	<0.20	1.41
19:30	<0.20	<0.20	<0.20	-	0.35	0.79	<0.20	1.22
20:00	<0.20	<0.20	0.36	0.84	0.39	0.58	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	0.46	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	0.42	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	0.45	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	0.36	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	0.43	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	0.31	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 18. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	0.34	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	0.53	<0.20	-	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	0.57	-	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	0.42	-	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	0.62	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	0.40	-	1.84	1.89
11:30	0.76	<0.20	<0.20	<0.20	0.61	-	2.19	2.72
12:00	<0.20	<0.20	<0.20	<0.20	0.59	-	1.06	1.53
12:30	<0.20	<0.20	<0.20	<0.20	0.66	-	0.60	1.90
13:00	<0.20	<0.20	0.51	0.43	0.66	-	0.55	1.30
13:30	<0.20	<0.20	<0.20	0.51	0.58	-	0.84	0.57
14:00	<0.20	<0.20	0.41	0.48	0.53	-	0.67	0.79
14:30	<0.20	<0.20	<0.20	0.54	0.50	-	0.53	0.87
15:00	<0.20	<0.20	0.50	0.66	0.51	0.46	0.83	0.41
15:30	<0.20	<0.20	<0.20	0.65	0.43	0.59	0.36	<0.20
16:00	<0.20	0.36	0.42	0.64	0.48	-	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	0.61	0.38	0.51	<0.20	<0.20
17:00	<0.20	0.41	<0.20	0.60	<0.20	0.54	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	0.57	0.37	0.57	<0.20	<0.20
18:00	<0.20	0.61	<0.20	0.52	0.44	0.51	<0.20	<0.20
18:30	<0.20	0.56	<0.20	0.53	0.48	0.38	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	0.46	0.46	0.38	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	0.54	-	0.37	0.37	<0.20
20:00	<0.20	<0.20	<0.20	0.52	-	0.38	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	0.46	-	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	0.39	-	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	0.45	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	0.48	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	0.47	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	0.49	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	0.49	<0.20

continued...

Table 18. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	0.59	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	0.58	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	0.45	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	0.38	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	0.62	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	0.33	<0.20	<0.20	<0.20	<0.20	0.46	<0.20
12:00	0.67	0.81	<0.20	<0.20	<0.20	<0.20	0.43	<0.20
12:30	1.10	1.79	<0.20	<0.20	<0.20	<0.20	0.43	<0.20
13:00	1.29	2.78	0.84	<0.20	<0.20	<0.20	0.51	0.40
13:30	2.97	3.10	1.57	<0.20	<0.20	<0.20	0.49	0.54
14:00	0.33	1.07	1.97	<0.20	0.47	<0.20	0.48	0.68
14:30	0.57	<0.20	1.69	<0.20	0.57	<0.20	0.33	0.77
15:00	<0.20	1.12	1.71	<0.20	<0.20	<0.20	<0.20	0.82
15:30	<0.20	0.78	1.08	<0.20	0.36	<0.20	<0.20	0.80
16:00	<0.20	1.12	1.14	<0.20	0.41	<0.20	<0.20	0.54
16:30	<0.20	0.37	1.00	<0.20	0.36	<0.20	<0.20	0.44
17:00	<0.20	<0.20	0.85	<0.20	<0.20	<0.20	<0.20	0.78
17:30	<0.20	<0.20	0.74	<0.20	<0.20	<0.20	<0.20	0.75
18:00	<0.20	<0.20	0.65	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	0.59	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	0.56	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.49
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.39
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 18. Concluded.

Day	25	26	27	28	29	30
Time						
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
12:00	<0.20	<0.20	<0.20	<0.20	-	-
12:30	<0.20	<0.20	<0.20	<0.20	-	-
13:00	<0.20	<0.20	<0.20	<0.20	-	-
13:30	<0.20	<0.20	<0.20	<0.20	-	-
14:00	<0.20	<0.20	<0.20	<0.20	-	-
14:30	<0.20	<0.20	<0.20	<0.20	-	-
15:00	<0.20	<0.20	0.33	<0.20	-	-
15:30	<0.20	<0.20	0.33	<0.20	-	-
16:00	<0.20	<0.20	0.34	<0.20	-	-
16:30	<0.20	<0.20	<0.20	<0.20	-	-
17:00	<0.20	<0.20	0.38	<0.20	-	-
17:30	<0.20	<0.20	<0.20	<0.20	-	-
18:00	<0.20	0.47	<0.20	<0.20	-	-
18:30	<0.20	0.47	<0.20	<0.20	-	-
19:00	<0.20	0.48	<0.20	<0.20	-	-
19:30	<0.20	0.31	<0.20	<0.20	-	-
20:00	<0.20	0.37	<0.20	<0.20	-	-
20:30	<0.20	<0.20	<0.20	<0.20	-	-
21:00	<0.20	<0.20	<0.20	<0.20	-	-
21:30	<0.20	<0.20	<0.20	<0.20	-	-
22:00	<0.20	<0.20	<0.20	<0.20	-	-
22:30	<0.20	<0.20	<0.20	<0.20	-	-
23:00	<0.20	<0.20	<0.20	<0.20	-	-
23:30	<0.20	<0.20	<0.20	<0.20	-	-
24:00	<0.20	<0.20	<0.20	<0.20	-	-

Table 19. PAN concentrations in downtown Calgary, 1981 October.

Day	1	2	3	4	5	6	7	8
Time								
00:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	-	-	-	<0.20	0.69	<0.20	<0.20	<0.20
12:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	-	-	-	0.50	<0.20	<0.20	<0.20	<0.20
18:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	-	-	-	<0.20	<0.20	<0.20	1.20	<0.20
21:00	-	-	-	<0.20	<0.20	<0.20	0.93	<0.20
21:30	-	-	-	<0.20	<0.20	<0.20	0.56	<0.20
22:00	-	-	<0.20	0.45	<0.20	<0.20	<0.20	<0.20
22:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 19. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	0.62	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	0.70	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	0.53	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	0.56	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
19:00	<0.20	0.45	<0.20	<0.20	<0.20	<0.20	<0.20	-
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-

continued...

Table 19. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	-	<0.20	<0.20	<0.20	<0.20	0.40	<0.20	<0.20
17:00	-	<0.20	<0.20	<0.20	<0.20	0.45	<0.20	<0.20
17:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	-	<0.20	<0.20	<0.20	<0.20	0.41	<0.20	<0.20
19:00	-	<0.20	<0.20	<0.20	<0.20	0.44	<0.20	<0.20
19:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	-	<0.20	<0.20	<0.20	<0.20	0.38	<0.20	<0.20
22:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 19. Concluded.

Day	25	26	27	28	29	30	31
Time							
00:30	<0.20	-	-	<0.20	<0.20	-	-
01:00	<0.20	-	-	<0.20	<0.20	-	-
01:30	<0.20	-	-	<0.20	<0.20	-	-
02:00	<0.20	-	-	<0.20	<0.20	-	-
02:30	<0.20	-	-	<0.20	<0.20	-	-
03:00	<0.20	-	-	<0.20	<0.20	-	-
03:30	<0.20	-	-	<0.20	<0.20	-	-
04:00	<0.20	-	-	<0.20	<0.20	-	-
04:30	<0.20	-	-	<0.20	<0.20	-	-
05:00	<0.20	-	-	<0.20	<0.20	-	-
05:30	<0.20	-	-	<0.20	<0.20	-	-
06:00	<0.20	-	-	<0.20	<0.20	-	-
06:30	<0.20	-	-	<0.20	<0.20	-	-
07:00	<0.20	-	-	<0.20	<0.20	-	-
07:30	<0.20	-	-	<0.20	<0.20	-	-
08:00	<0.20	-	-	<0.20	<0.20	-	-
08:30	<0.20	-	-	<0.20	<0.20	-	-
09:00	-	-	-	<0.20	<0.20	-	-
09:30	-	-	-	<0.20	<0.20	-	-
10:00	-	-	-	<0.20	<0.20	-	-
10:30	-	-	-	<0.20	<0.20	-	-
11:00	-	-	-	<0.20	<0.20	-	-
11:30	-	-	-	<0.20	<0.20	-	-
12:00	-	-	-	<0.20	<0.20	-	-
12:30	-	-	<0.20	<0.20	<0.20	-	-
13:00	-	-	<0.20	<0.20	<0.20	-	-
13:30	-	-	<0.20	<0.20	<0.20	-	-
14:00	-	-	<0.20	<0.20	0.55	-	-
14:30	-	-	<0.20	<0.20	0.74	-	-
15:00	-	-	<0.20	<0.20	0.72	-	-
15:30	-	-	<0.20	<0.20	0.58	-	-
16:00	-	-	<0.20	<0.20	-	-	-
16:30	-	-	<0.20	<0.20	-	-	-
17:00	-	-	<0.20	<0.20	-	-	-
17:30	-	-	<0.20	<0.20	-	-	-
18:00	-	-	<0.20	<0.20	-	-	-
18:30	-	-	<0.20	<0.20	-	-	-
19:00	-	-	<0.20	<0.20	-	-	-
19:30	-	-	<0.20	<0.20	-	-	-
20:00	-	-	<0.20	<0.20	-	-	-
20:30	-	-	<0.20	<0.20	-	-	-
21:00	-	-	<0.20	<0.20	-	-	-
21:30	-	-	<0.20	<0.20	-	-	-
22:00	-	-	<0.20	<0.20	-	-	-
22:30	-	-	<0.20	<0.20	-	-	-
23:00	-	-	<0.20	<0.20	-	-	-
23:30	-	-	<0.20	<0.20	-	-	-
24:00	-	-	<0.20	<0.20	-	-	-

Table 20. PAN concentrations in downtown Calgary, 1981 November.

Day	1	2	3	4	5	6	7	8
Time								
00:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	-	-	1.25	0.45	<0.20	<0.20	<0.20	<0.20
14:00	-	<0.20	0.62	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	-	<0.20	<0.20	0.50	<0.20	<0.20	<0.20	<0.20
18:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	-	<0.20	<0.20	0.45	<0.20	<0.20	<0.20	<0.20
22:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 20. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 20. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.38	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 20. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 20. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.38	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 20. Concluded.

Day	25	26	27	28	29	30
Time						
00:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	-	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	-	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	-
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	-
14:00	<0.20	<0.20	<0.20	<0.20	0.47	-
14:30	<0.20	<0.20	<0.20	<0.20	0.64	-
15:00	<0.20	<0.20	<0.20	<0.20	0.61	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	0.48	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	-	<0.20	<0.20	<0.20

Table 21. PAN concentrations in downtown Calgary, 1981 December.

Day	1	2	3	4	5	6	7	8
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.42
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.38
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.47
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.56
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.53
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.48
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.50
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.34

continued...

Table 21. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 21. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.38	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 21. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 21. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.38	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 21. Concluded.

Day	25	26	27	28	29	30	31
Time							
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table 22. PAN concentrations in downtown Calgary, 1982 January.

Day	1	2	3	4	5	6	7	8
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
03:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
03:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
04:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
04:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
05:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
05:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
06:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
06:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	-
07:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
07:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
08:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
08:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
09:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
09:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
10:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
10:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
11:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
11:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
12:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
12:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
13:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
13:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
14:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
14:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
15:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
15:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
16:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
16:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
17:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
17:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
18:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
18:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
19:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
19:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
20:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
20:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
21:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
21:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
22:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
22:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
23:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
23:30	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-
24:00	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-

continued...

Table 22. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
01:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
01:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
02:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
02:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
03:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
03:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
04:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
04:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
05:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
05:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
06:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
06:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
07:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
07:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
08:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
08:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
09:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
09:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
10:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
10:30	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
11:00	-	-	<0.20	<0.20	<0.20	<0.20	-	<0.20
11:30	-	-	<0.20	<0.20	<0.20	-	-	<0.20
12:00	-	-	<0.20	<0.20	<0.20	-	-	<0.20
12:30	-	-	<0.20	<0.20	<0.20	-	-	<0.20
13:00	-	-	<0.20	<0.20	<0.20	-	-	<0.20
13:30	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
14:00	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
14:30	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
15:00	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
15:30	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
16:00	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
16:30	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
17:00	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
17:30	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
18:00	-	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
18:30	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
19:00	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
19:30	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
20:00	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
20:30	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
21:00	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
21:30	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
22:00	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
22:30	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
23:00	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
23:30	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
24:00	-	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20

continued...

Table 22. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	0.48
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	0.59
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	0.45
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20

continued...

Table 22. Concluded.

Day	25	26	27	28	29	30	31
Time							
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	0.49	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	0.44	<0.20	0.46	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.74	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.70	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.72	<0.20
14:30	0.64	<0.20	<0.20	<0.20	<0.20	0.74	<0.20
15:00	0.89	<0.20	<0.20	<0.20	<0.20	0.76	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.59	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.61	<0.20
16:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.53	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table 23. PAN concentrations in downtown Calgary, 1982 February.

Day	1	2	3	4	5	6	7	8
Time								
00:30	<0.20	<0.20	0.46	<0.20	<0.20	<0.20	<0.20	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
14:30	<0.20	<0.20	<0.20	<0.20	0.50	<0.20	<0.20	<0.20
15:00	<0.20	<0.20	<0.20	<0.20	0.63	<0.20	<0.20	<0.20
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	<0.20	0.41	<0.20	0.52	<0.20	<0.20	<0.20	<0.20
17:00	<0.20	<0.20	<0.20	<0.20	0.47	<0.20	<0.20	<0.20
17:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.45	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	0.48	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 23. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.64	0.53	<0.20
01:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.62	0.56	<0.20
01:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.61	0.56	<0.20
02:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.53	0.54	<0.20
02:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.50	0.53	<0.20
03:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.43	0.55	<0.20
03:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.44	0.54	<0.20
04:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.52	<0.20
04:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.54	<0.20
05:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.55	<0.20
05:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.46	<0.20
06:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.51	<0.20
06:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.53	<0.20
07:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.56	<0.20
07:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.56	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.56	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.58	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.57	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.59	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	0.41	<0.20	0.61	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	0.44	<0.20	0.64	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	0.44	<0.20	0.63	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	0.49	<0.20	0.64	<0.20
12:00	<0.20	<0.20	<0.20	<0.20	0.48	<0.20	0.67	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	0.51	0.41	0.72	<0.20
13:00	<0.20	<0.20	<0.20	<0.20	0.56	0.45	0.75	<0.20
13:30	<0.20	<0.20	<0.20	<0.20	0.59	0.51	0.78	0.52
14:00	<0.20	<0.20	<0.20	<0.20	0.64	0.55	0.79	0.55
14:30	<0.20	<0.20	<0.20	<0.20	0.67	0.56	0.92	<0.20
15:00	0.47	<0.20	<0.20	<0.20	0.66	0.58	1.01	0.57
15:30	<0.20	<0.20	<0.20	<0.20	0.67	0.54	1.08	<0.20
16:00	<0.20	<0.20	<0.20	<0.20	0.58	0.57	0.92	<0.20
16:30	0.62	<0.20	0.40	<0.20	0.61	0.59	0.94	<0.20
17:00	0.54	<0.20	0.43	<0.20	0.60	0.57	0.95	<0.20
17:30	0.53	<0.20	<0.20	<0.20	0.60	0.57	0.97	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	0.61	0.58	0.95	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	0.60	0.52	0.97	<0.20
19:00	0.42	<0.20	<0.20	<0.20	0.60	0.55	0.84	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	0.61	0.53	0.76	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	0.60	0.57	0.80	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	0.62	0.55	0.73	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	0.60	0.55	0.76	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	0.60	0.55	0.68	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	0.58	0.54	0.65	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	0.62	0.54	0.64	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	0.61	0.51	0.59	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	0.61	<0.20	0.53	0.50
24:00	<0.20	<0.20	<0.20	<0.20	0.60	0.53	0.52	<0.20

continued...

Table 23. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
01:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
01:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
02:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
02:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
03:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
03:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
04:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
04:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
05:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
05:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
06:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
06:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
07:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
07:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
08:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
08:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
09:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
09:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
10:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
10:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
11:00	<0.20	-	<0.20	0.43	<0.20	-	<0.20	<0.20
11:30	<0.20	-	<0.20	0.90	<0.20	-	<0.20	<0.20
12:00	<0.20	-	0.53	1.20	<0.20	-	<0.20	<0.20
12:30	<0.20	-	<0.20	1.64	<0.20	-	<0.20	<0.20
13:00	<0.20	-	<0.20	1.78	<0.20	-	<0.20	<0.20
13:30	<0.20	-	<0.20	1.63	<0.20	-	<0.20	<0.20
14:00	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
14:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
15:00	<0.20	-	0.47	<0.20	<0.20	-	<0.20	<0.20
15:30	<0.20	-	0.48	<0.20	<0.20	-	<0.20	0.39
16:00	<0.20	-	0.40	<0.20	<0.20	-	<0.20	<0.20
16:30	<0.20	-	<0.20	<0.20	<0.20	-	<0.20	<0.20
17:00	0.49	-	<0.20	<0.20	<0.20	-	<0.20	0.41
17:30	0.60	-	<0.20	<0.20	<0.20	-	<0.20	0.44
18:00	0.53	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.43
18:30	0.52	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.42
19:00	0.43	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	0.42	<0.20	<0.20	<0.20	<0.20	<0.20	0.41	<0.20
20:00	0.39	0.38	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
22:00	-	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20
22:30	-	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20
23:00	-	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20
23:30	-	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20
24:00	-	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20

continued...

Table 23. Concluded.

Day	25	26	27	28
Time				
00:30	<0.20	0.45	0.55	-
01:00	<0.20	0.44	0.55	-
01:30	<0.20	0.46	0.53	-
02:00	<0.20	0.42	0.54	-
02:30	<0.20	0.43	0.54	-
03:00	<0.20	0.43	0.54	-
03:30	<0.20	0.41	0.50	-
04:00	<0.20	<0.20	0.50	-
04:30	<0.20	0.42	0.51	-
05:00	<0.20	0.44	0.51	-
05:30	<0.20	0.42	0.51	-
06:00	<0.20	0.44	0.53	-
06:30	<0.20	0.45	0.53	-
07:00	<0.20	0.46	0.54	-
07:30	<0.20	0.49	0.53	-
08:00	<0.20	0.43	-	-
08:30	<0.20	0.43	-	-
09:00	<0.20	0.44	-	-
09:30	<0.20	<0.20	-	-
10:00	0.45	0.42	-	-
10:30	0.43	0.47	-	-
11:00	0.43	0.49	-	-
11:30	<0.20	0.51	-	<0.20
12:00	0.42	0.48	-	<0.20
12:30	0.48	0.51	-	<0.20
13:00	0.50	0.51	-	<0.20
13:30	0.48	0.52	-	<0.20
14:00	0.49	0.53	-	<0.20
14:30	0.52	0.60	-	<0.20
15:00	0.52	0.60	-	<0.20
15:30	0.52	0.60	-	<0.20
16:00	0.49	0.60	-	<0.20
16:30	0.49	0.59	-	<0.20
17:00	0.49	0.56	-	<0.20
17:30	0.48	0.56	-	<0.20
18:00	0.48	0.57	-	<0.20
18:30	0.48	0.56	-	<0.20
19:00	0.49	0.54	-	<0.20
19:30	0.48	0.54	-	<0.20
20:00	0.47	0.55	-	<0.20
20:30	0.47	0.54	-	<0.20
21:00	0.46	0.54	-	<0.20
21:30	0.45	0.51	-	<0.20
22:00	0.46	0.53	-	<0.20
22:30	0.46	0.53	-	<0.20
23:00	0.44	0.53	-	<0.20
23:30	0.43	0.53	-	<0.20
24:00	0.41	0.53	-	-

Table 24. PAN concentrations in downtown Calgary, 1982 March.

Day	1	2	3	4	5	6	7	8
Time								
00:30	-	-	0.34	0.40	0.77	<0.20	<0.20	-
01:00	-	0.34	0.39	0.61	<0.20	<0.20	0.43	<0.20
01:30	0.35	0.35	0.50	<0.20	<0.20	0.37	<0.20	<0.20
02:00	0.34	<0.20	<0.20	<0.20	0.36	<0.20	<0.20	-
02:30	<0.20	<0.20	<0.20	0.38	<0.20	<0.20	-	-
03:00	<0.20	<0.20	0.38	<0.20	<0.20	-	-	<0.20
03:30	<0.20	0.48	<0.20	-	-	-	<0.20	0.37
04:00	0.55	<0.20	-	-	-	<0.20	0.37	<0.20
04:30	0.41	-	-	-	<0.20	0.39	<0.20	0.36
05:00	-	-	-	0.38	0.68	<0.20	<0.20	0.29
05:30	-	-	0.36	0.76	<0.20	<0.20	0.50	0.83
06:00	-	0.40	0.78	<0.20	0.16	0.49	0.84	0.44
06:30	0.35	0.76	<0.20	<0.20	0.49	0.72	0.45	-
07:00	0.69	<0.20	<0.20	0.51	0.72	<0.20	-	-
07:30	<0.20	<0.20	0.41	<0.20	<0.20	-	-	0.33
08:00	<0.20	-	<0.20	<0.20	-	-	0.35	0.40
08:30	0.47	0.31	0.28	0.38	<0.20	<0.20	<0.20	<0.20
09:00	0.22	0.26	0.36	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	0.28	0.39	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.42	0.34
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.49	0.43	0.46
12:00	<0.20	<0.20	<0.20	<0.20	0.53	0.63	0.57	<0.20
12:30	<0.20	<0.20	<0.20	0.44	0.46	0.39	<0.20	<0.20
13:00	<0.20	<0.20	0.34	0.41	0.38	<0.20	<0.20	<0.20
13:30	<0.20	0.24	0.36	0.40	<0.20	<0.20	0.67	<0.20
14:00	<0.20	0.32	0.48	<0.20	<0.20	0.58	<0.20	0.30
14:30	<0.20	0.58	<0.20	<0.20	1.07	<0.20	0.39	<0.20
15:00	0.45	<0.20	<0.20	<0.20	<0.20	0.30	<0.20	0.29
15:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.35	<0.20	0.32
16:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.31	0.48	<0.20
16:30	<0.20	0.41	<0.20	<0.20	<0.20	<0.20	<0.20	0.35
17:00	<0.20	<0.20	<0.20	0.35	<0.20	<0.20	<0.20	0.28
17:30	0.25	0.34	<0.20	<0.20	<0.20	0.29	<0.20	<0.20
18:00	<0.20	0.27	<0.20	0.31	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	<0.20	<0.20	0.23	<0.20	0.31	<0.20	<0.20
19:00	<0.20	<0.20	<0.20	<0.20	0.28	0.41	0.48	0.38
19:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.76	0.80
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	0.31	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	0.34	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	<0.20	<0.20	0.68	0.34	0.50	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	0.45	0.29	0.55	0.41
22:30	<0.20	0.29	<0.20	<0.20	<0.20	<0.20	<0.20	0.29
23:00	0.54	<0.20	<0.20	0.27	<0.20	<0.20	<0.20	<0.20
23:30	<0.20	0.46	0.59	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	0.38	0.58	<0.20	0.29	<0.20

continued...

Table 24. Continued.

Day	9	10	11	12	13	14	15	16
Time								
00:30	<0.20	<0.20	-	-	<0.20	0.41	0.73	<0.20
01:00	<0.20	-	-	0.37	0.35	0.60	<0.20	<0.20
01:30	-	-	<0.20	0.36	0.46	<0.20	<0.20	0.35
02:00	-	0.34	0.35	<0.20	<0.20	<0.20	0.35	<0.20
02:30	<0.20	0.35	<0.20	<0.20	<0.20	0.38	<0.20	<0.20
03:00	0.35	<0.20	<0.20	<0.20	0.41	<0.20	<0.20	-
03:30	<0.20	<0.20	<0.20	0.48	<0.20	-	-	-
04:00	<0.20	<0.20	0.57	0.62	-	-	-	<0.20
04:30	<0.20	1.57	0.66	-	-	-	0.36	0.46
05:00	1.03	0.65	-	-	-	<0.20	0.77	<0.20
05:30	0.69	-	-	-	0.40	0.80	<0.20	<0.20
06:00	-	-	-	0.40	0.78	<0.20	0.21	0.34
06:30	-	0.38	0.39	0.76	<0.20	<0.20	0.63	0.80
07:00	<0.20	0.39	0.63	<0.20	<0.20	0.42	0.55	<0.20
07:30	0.41	0.80	<0.20	<0.20	-	<0.20	<0.20	-
08:00	0.81	<0.20	<0.20	-	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	0.30	<0.20	<0.20	0.36	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	0.26	0.38	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	0.37	<0.20	<0.20	<0.20	<0.20
10:00	<0.20	0.31	0.26	<0.20	<0.20	<0.20	<0.20	<0.20
10:30	0.28	0.28	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:00	0.30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.54
12:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.41	0.92
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.45	0.41	0.39
13:00	<0.20	0.29	<0.20	<0.20	0.32	0.32	0.37	<0.20
13:30	0.38	<0.20	<0.20	0.26	0.32	0.42	<0.20	<0.20
14:00	<0.20	0.40	0.28	0.37	0.52	<0.20	<0.20	0.37
14:30	0.32	0.37	0.24	0.47	<0.20	<0.20	1.12	<0.20
15:00	0.39	0.32	0.52	<0.20	<0.20	<0.20	<0.20	<0.20
15:30	0.36	0.36	<0.20	<0.20	<0.20	<0.20	<0.20	0.27
16:00	0.31	<0.20	0.37	<0.20	<0.20	<0.20	<0.20	<0.20
16:30	0.47	<0.20	<0.20	<0.20	0.36	<0.20	<0.20	<0.20
17:00	0.33	0.32	0.48	<0.20	<0.20	<0.20	0.30	<0.20
17:30	<0.20	<0.20	0.28	<0.20	0.31	<0.20	<0.20	<0.20
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.31	<0.20
18:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.32	0.31
19:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.46
19:30	0.49	0.26	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:00	0.24	0.35	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	0.24	0.34	<0.20	<0.20	<0.20	<0.20
21:00	<0.20	<0.20	<0.20	0.51	<0.20	0.43	<0.20	<0.20
21:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.59	0.40	0.65
22:00	<0.20	<0.20	0.27	<0.20	<0.20	<0.20	<0.20	0.34
22:30	0.36	0.57	<0.20	<0.20	0.27	<0.20	<0.20	<0.20
23:00	<0.20	0.34	0.44	0.54	<0.20	<0.20	0.34	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	0.44	0.63	<0.20	<0.20
24:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.38	0.63

continued...

Table 24. Continued.

Day	17	18	19	20	21	22	23	24
Time								
00:30	<0.20	0.39	<0.20	<0.20	-	-	0.35	0.41
01:00	0.39	<0.20	<0.20	-	-	0.33	0.37	0.57
01:30	<0.20	<0.20	-	-	<0.20	0.35	<0.20	<0.20
02:00	<0.20	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
02:30	-	-	<0.20	0.38	<0.20	<0.20	<0.20	0.42
03:00	-	0.32	<0.20	<0.20	<0.20	<0.20	0.44	<0.20
03:30	<0.20	0.37	<0.20	<0.20	<0.20	0.53	<0.20	-
04:00	0.40	<0.20	<0.20	<0.20	0.67	0.44	-	-
04:30	<0.20	0.25	0.19	1.34	0.66	-	-	-
05:00	<0.20	0.38	0.96	0.54	-	-	-	0.39
05:30	0.56	0.78	0.69	-	-	-	0.41	0.76
06:00	0.80	0.46	-	-	-	0.39	0.87	<0.20
06:30	0.47	-	-	<0.20	0.37	0.75	<0.20	<0.20
07:00	-	-	<0.20	0.39	0.70	<0.20	<0.20	0.39
07:30	-	<0.20	0.46	0.85	<0.20	<0.20	-	<0.20
08:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.55	0.30	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.35
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.28	0.41	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	0.28	0.37	<0.20	<0.20
10:00	<0.20	<0.20	<0.20	0.27	<0.20	<0.20	<0.20	<0.20
10:30	<0.20	0.28	0.29	0.31	<0.20	<0.20	<0.20	<0.20
11:00	0.50	0.30	0.41	<0.20	<0.20	<0.20	<0.20	<0.20
11:30	0.46	0.49	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:00	0.47	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
12:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.40
13:00	<0.20	<0.20	<0.20	0.34	<0.20	<0.20	0.25	0.33
13:30	<0.20	<0.20	0.21	<0.20	0.30	<0.20	0.33	0.49
14:00	<0.20	0.36	<0.20	0.32	0.40	0.27	0.49	<0.20
14:30	0.32	<0.20	0.32	0.39	<0.20	0.50	<0.20	<0.20
15:00	<0.20	0.27	0.37	0.35	0.47	<0.20	<0.20	<0.20
15:30	0.33	0.29	0.36	0.40	<0.20	<0.20	<0.20	<0.20
16:00	0.33	0.45	<0.20	<0.20	<0.20	0.39	<0.20	<0.20
16:30	<0.20	0.31	0.35	0.45	<0.20	<0.20	<0.20	0.35
17:00	<0.20	<0.20	0.32	0.32	0.24	0.38	<0.20	<0.20
17:30	0.27	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.31
18:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.25
18:30	0.32	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
19:00	0.74	0.56	0.40	<0.20	<0.20	<0.20	<0.20	<0.20
19:30	<0.20	1.05	0.39	0.47	<0.20	<0.20	<0.20	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	0.33	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	0.24	0.34	<0.20
21:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.65	0.27
21:30	<0.20	<0.20	<0.20	0.27	<0.20	<0.20	<0.20	<0.20
22:00	<0.20	0.43	0.47	<0.20	<0.20	0.29	<0.20	<0.20
22:30	<0.20	<0.20	0.31	0.42	0.55	<0.20	<0.20	<0.20
23:00	<0.20	<0.20	<0.20	<0.20	0.28	0.44	0.60	<0.20
23:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.42
24:00	<0.20	0.29	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

continued...

Table 24. Concluded.

Day	25	26	27	28	29	30	31
Time							
00:30	0.65	<0.20	<0.20	0.43	<0.20	<0.20	-
01:00	<0.20	<0.20	0.38	<0.20	<0.20	-	-
01:30	<0.20	0.36	<0.20	<0.20	-	-	<0.20
02:00	0.36	<0.20	<0.20	-	-	<0.20	0.35
02:30	<0.20	<0.20	-	-	<0.20	<0.20	<0.20
03:00	<0.20	-	-	0.31	0.35	<0.20	<0.20
03:30	-	-	<0.20	0.34	<0.20	<0.20	<0.20
04:00	-	0.35	0.43	<0.20	0.42	<0.20	1.18
04:30	0.37	0.65	<0.20	<0.20	0.25	1.18	0.58
05:00	0.81	<0.20	<0.20	0.38	0.89	0.54	-
05:30	<0.20	<0.20	0.58	0.79	0.58	-	-
06:00	0.25	0.60	0.79	0.46	-	-	-
06:30	0.59	0.79	0.34	-	-	<0.20	0.38
07:00	<0.20	<0.20	-	-	<0.20	0.37	0.68
07:30	<0.20	-	-	<0.20	0.44	0.86	<0.20
08:00	0.39	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
08:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
09:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.29
10:00	<0.20	<0.20	<0.20	<0.20	<0.20	0.32	0.28
10:30	<0.20	<0.20	<0.20	0.36	0.29	0.30	<0.20
11:00	<0.20	<0.20	0.63	0.37	0.50	<0.20	<0.20
11:30	<0.20	0.60	0.56	0.49	<0.20	<0.20	<0.20
12:00	0.36	0.82	0.41	<0.20	<0.20	<0.20	<0.20
12:30	0.40	0.37	<0.20	<0.20	<0.20	<0.20	0.29
13:00	0.38	<0.20	<0.20	<0.20	<0.20	0.36	<0.20
13:30	<0.20	<0.20	0.70	<0.20	0.33	<0.20	0.32
14:00	<0.20	0.85	<0.20	0.40	<0.20	0.32	0.32
14:30	0.72	<0.20	0.32	0.27	0.33	-	0.28
15:00	<0.20	<0.20	<0.20	0.30	0.31	0.36	0.45
15:30	<0.20	0.87	0.32	0.28	0.38	0.38	0.37
16:00	<0.20	<0.20	0.24	0.31	0.50	<0.20	<0.20
16:30	<0.20	<0.20	<0.20	0.26	0.30	0.28	0.42
17:00	<0.20	0.32	<0.20	<0.20	<0.20	0.28	0.31
17:30	<0.20	<0.20	<0.20	0.27	<0.20	<0.20	<0.20
18:00	<0.20	0.29	<0.20	<0.20	<0.20	<0.20	<0.20
18:30	<0.20	0.27	0.33	0.38	<0.20	<0.20	<0.20
19:00	<0.20	<0.20	0.75	0.82	0.45	0.35	<0.20
19:30	<0.20	<0.20	<0.20	<0.20	0.76	0.39	<0.20
20:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
20:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:00	0.44	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
21:30	0.41	0.36	0.69	0.33	<0.20	<0.20	<0.20
22:00	<0.20	<0.20	<0.20	<0.20	0.41	0.57	<0.20
22:30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.46
23:00	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23:30	0.60	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
24:00	0.24	0.33	0.50	<0.20	0.29	<0.20	<0.20

9.2 CONCENTRATIONS OF PAN IN THE AMBIENT ATMOSPHERE AT THE UNIVERSITY OF CALGARY, 1980 DECEMBER TO 1981 AUGUST

Table 25. PAN concentrations at the University of Calgary, 1980 December.

Time	Day 1	2	3	4	5	6	7	8	9	10
0800	-	0.13	0.06	-	-	-	-	-	<.06	0.11
0900	0.13	0.13	0.06	0.13	0.11	-	-	<.06	<.06	0.13
1000	0.10	0.16	0.06	0.10	0.10	-	-	<.06	<.06	0.13
1100	0.13	0.16	0.13	0.16	0.10	-	-	<.06	0.10	0.16
1130	-	0.16	-	-	-	-	-	-	-	-
1200	0.13	0.19	0.10	0.10	0.11	-	-	<.06	-	0.19
1300	0.10	0.16	0.10	0.19	0.10	-	-	0.10	0.13	0.16
1400	0.16	0.16	0.10	0.16	0.06	-	-	0.19	0.13	0.19
1420	-	-	-	-	-	-	-	0.16	-	0.19
1430	-	-	-	-	-	-	-	-	0.13	-
1440	-	-	-	-	-	-	-	0.13	-	0.21
1500	0.16	0.13	0.16	0.14	0.06	-	-	0.16	0.16	0.21
1520	0.22	-	0.16	-	-	-	-	-	-	0.19
1530	-	-	-	-	-	-	-	-	0.13	-
1540	0.16	-	0.19	-	-	-	-	-	-	0.11
1600	0.16	0.13	0.19	0.13	0.10	-	-	0.29	0.13	0.13
1620	-	-	0.16	-	-	-	-	0.22	-	-
1630	-	-	-	-	-	-	-	-	0.13	0.13
1640	-	-	0.13	-	-	-	-	0.19	-	-
1700	-	-	-	-	-	-	-	0.16	-	0.13
1730	-	-	-	-	-	-	-	0.19	-	0.13
1800	-	-	-	-	-	-	-	-	-	0.08
1830	-	-	-	-	-	-	-	-	-	0.13

continued...

Table 25. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	0.06	-	-	<.06	0.00	0.00	<.06	-	-
0900	0.00	<.06	-	-	0.00	0.00	0.00	<.06	0.00	-
1000	0.10	<.06	-	-	0.00	0.00	<.06	<.06	0.00	-
1100	0.00	0.06	-	-	0.00	0.00	0.00	<.06	<.06	-
1200	0.00	0.08	-	-	0.00	0.00	<.06	0.10	0.06	-
1300	0.00	0.13	-	-	0.00	0.00	<.06	-	0.10	-
1400	<.06	0.13	-	-	0.00	0.00	<.06	0.06	0.10	-
1420	-	-	0.11	-	-	-	-	-	-	-
1440	-	0.10	-	-	-	-	-	-	-	-
1500	<.06	0.06	-	-	0.00	0.00	<.06	0.06	0.10	-
1530	-	0.06	-	-	-	-	-	-	-	-
1600	0.06	0.06	-	-	0.00	0.00	<.06	0.10	0.06	-

continued...

Table 25. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0800	-	-	0.10	-	-	-	-	-	0.14	0.00	-
0900	-	0.19	0.06	-	-	-	-	0.13	0.00	0.00	0.00
0920	-	0.16	-	-	-	-	-	-	-	-	-
0940	-	0.13	-	-	-	-	-	-	-	-	-
1000	-	0.11	0.10	0.13	-	-	-	-	0.00	0.00	0.00
1020	-	0.13	-	-	-	-	-	-	-	-	-
1040	-	0.14	-	-	-	-	-	-	-	-	-
1100	-	0.16	0.10	0.14	-	-	-	-	0.00	0.11	0.00
1120	-	-	-	-	-	-	-	-	-	0.11	-
1130	-	0.13	-	-	-	-	-	-	-	-	-
1140	-	-	-	-	-	-	-	-	-	0.10	-
1200	-	-	0.10	0.13	-	-	-	-	0.00	0.10	<.06
1230	-	-	-	-	-	-	-	-	-	0.08	-
1300	-	-	-	-	-	-	-	-	0.00	<.06	<.06
1400	-	0.13	0.10	-	-	-	-	-	0.00	<.06	0.11
1430	-	0.13	-	-	-	-	-	-	-	-	-
1500	-	0.14	-	-	-	-	-	-	0.00	<.06	0.13
1520	-	-	-	-	-	-	-	-	-	-	0.13
1540	-	-	-	-	-	-	-	-	-	-	0.13
1600	-	-	-	-	-	-	-	-	0.00	0.06	0.13

Table 26. PAN concentrations at the University of Calgary, 1981 January.

Time	Day 1	2	3	4	5	6	7	8	9	10
0800	-	-	-	-	0.00	0.00	0.00	-	<.10	<.10
0820	-	0.00	-	-	-	-	-	0.00	-	-
0900	-	0.00	-	-	0.00	0.00	0.00	0.00	<.10	<.10
1000	-	0.00	-	-	<.10	<.10	<.10	<.10	0.00	-
1030	-	-	-	-	-	<.10	<.10	-	-	-
1100	-	0.00	-	-	<.10	<.10	<.10	0.00	0.00	-
1200	-	0.00	<.10	<.10	<.10	<.10	<.10	0.00	0.00	-
1220	-	-	-	-	-	-	0.20	-	-	-
1240	-	-	-	-	0.23	-	0.20	-	-	-
1300	-	-	<.10	<.10	<.10	<.10	<.10	<.10	<.10	-
1320	-	0.35	-	-	-	-	0.25	-	-	-
1330	-	0.42	-	-	-	-	-	-	-	-
1340	-	0.35	-	-	-	-	0.25	-	-	-
1350	-	0.45	-	-	-	-	-	-	-	-
1400	-	0.47	-	-	<.10	<.10	<.10	0.10	0.00	-
1410	-	0.50	-	-	-	-	-	-	-	-
1420	-	0.45	-	-	-	-	0.27	-	-	-
1430	-	0.65	-	-	-	-	-	-	-	-
1440	-	0.35	-	-	-	-	0.30	-	-	-
1450	-	0.35	0.12	-	-	-	-	-	-	-
1500	-	0.30	<.10	<.10	<.10	<.10	<.10	0.10	<.10	<.10
1510	-	0.30	-	-	-	-	-	-	-	-
1520	-	0.30	-	-	-	-	0.20	-	-	-
1530	-	0.25	-	-	-	-	-	-	-	-
1540	-	0.20	-	-	-	-	0.17	-	-	-
1600	-	0.20	-	-	<.10	<.10	<.10	0.10	<.10	<.10
1630	-	0.15	-	-	-	-	0.10	-	-	-
1800	-	<.10	<.10	-	-	-	-	-	-	-

continued...

Table 26. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	0.00	0.00	-	-	0.10	-	-	0.00	0.00
0830	-	-	-	-	-	-	-	-	0.00	-
0900	-	0.00	0.00	0.00	0.00	0.10	-	-	-	0.00
0930	-	-	-	-	-	-	-	-	0.00	-
1000	-	0.00	0.00	0.00	0.00	0.15	-	-	0.00	0.00
1100	-	0.00	0.00	0.00	0.00	0.15	-	-	0.00	0.00
1200	-	0.00	0.00	0.00	0.17	0.20	-	-	<.10	0.00
1220	-	-	-	-	0.15	-	-	-	-	-
1230	-	-	-	-	-	0.27	-	-	-	-
1300	-	0.00	<.10	<.10	<.10	-	-	-	<.10	<.10
1320	-	-	-	-	0.30	-	-	-	-	-
1330	-	-	-	-	-	0.37	-	-	-	-
1340	-	-	-	-	0.32	0.50	-	-	-	-
1400	-	0.10	<.10	<.10	<.10	0.35	-	-	0.10	0.13
1420	-	-	-	-	0.22	0.30	-	-	-	-
1430	-	-	-	-	-	-	-	-	-	<.10
1440	-	-	-	-	0.17	0.22	-	-	-	-
1500	-	0.10	<.10	<.10	<.10	0.20	-	-	0.12	<.10
1520	-	-	-	-	0.15	0.12	-	-	-	-
1540	-	-	-	-	0.20	-	-	-	-	-
1600	-	0.00	0.10	0.15	0.17	0.10	-	-	0.10	<.10
1620	-	-	-	-	0.17	-	-	-	-	-
1630	-	-	-	-	-	0.10	-	-	-	-
1640	-	-	-	-	0.20	-	-	-	-	-
1710	-	-	-	-	0.90	-	-	-	-	<.10
1730	-	-	-	-	0.15	-	-	-	-	-
1750	-	-	-	-	0.45	-	-	-	-	-

continued...

Table 26. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0800	-	-	-	-	-	0.00	-	-	-	0.15	-
0810	0.00	-	-	-	-	-	-	-	-	-	-
0820	-	0.00	0.00	-	-	-	-	0.10	0.10	-	-
0900	0.00	0.00	0.00	-	-	-	0.00	0.10	-	0.17	-
0910	-	-	-	-	-	-	-	-	0.10	-	-
0920	-	-	-	-	-	0.00	-	-	-	-	-
1000	<.10	<.10	0.10	-	-	-	0.15	0.10	0.10	-	-
1010	-	-	-	-	-	0.00	-	-	-	-	-
1030	0.10	-	-	-	-	-	0.17	-	-	-	-
1100	0.10	0.00	0.15	-	-	<.10	<.10	0.10	0.17	-	-
1120	-	-	-	-	-	-	0.32	-	-	-	-
1130	0.10	-	0.15	-	-	-	-	-	-	-	-
1140	-	-	-	-	-	-	0.30	-	-	-	-
1200	-	0.00	0.22	-	-	0.10	0.35	0.12	0.27	0.10	-
1220	-	-	0.20	-	-	-	0.42	-	-	-	-
1240	-	-	0.20	-	-	-	0.87	-	-	-	-
1250	-	-	-	-	-	-	1.07	-	-	-	-
1300	-	0.00	0.10	-	-	0.20	1.15	0.12	0.45	0.22	-
1310	-	-	-	-	-	-	1.05	-	-	-	-
1320	-	-	0.12	-	-	0.45	1.10	-	-	0.27	-
1330	-	-	-	-	-	0.30	1.22	0.12	0.50	-	-
1340	-	-	0.10	-	-	0.35	1.25	-	-	0.22	-
1350	-	-	-	-	-	0.27	1.52	-	-	-	-
1400	<.10	<.10	0.12	-	-	0.25	2.05	0.12	0.40	0.25	-
1410	-	-	-	-	-	-	2.30	-	-	-	-
1420	-	-	-	0.20	-	-	1.95	-	-	0.27	-
1430	-	-	0.10	-	-	-	1.85	-	-	-	-
1440	-	-	-	-	-	0.17	1.70	-	0.37	0.22	-
1450	-	-	-	-	-	-	1.65	-	-	-	-
1500	0.00	0.00	0.20	-	-	<.10	<.10	0.10	0.47	0.12	-
1510	-	-	-	-	-	-	1.35	-	0.47	-	-
1520	-	-	0.17	-	-	-	1.65	-	0.40	-	-
1530	-	-	0.22	-	-	-	1.05	-	0.40	-	-
1540	-	-	0.15	-	-	-	0.82	-	0.37	-	-
1600	0.00	0.00	-	-	-	0.12	0.82	0.10	0.35	0.17	-
1620	-	-	-	-	-	-	0.60	-	0.30	-	-
1640	-	-	-	-	-	-	0.43	-	0.30	-	-
1700	-	-	-	-	-	-	0.37	-	0.20	-	-
1720	-	-	0.15	-	-	-	0.30	-	-	-	-
1730	-	-	-	-	-	-	-	-	0.17	-	-
1740	-	-	-	-	-	-	0.35	-	-	-	-
1800	-	-	-	-	-	-	0.30	-	-	-	-
1830	-	-	-	-	-	-	0.32	-	-	-	-
*1930	-	-	-	-	-	-	0.35	-	-	-	-
*2000	-	-	-	-	-	-	0.30	-	-	-	-
*2120	-	-	-	-	-	-	0.25	-	-	-	-
*2140	-	-	-	-	-	-	0.15	-	-	-	-
*2150	-	-	-	-	-	-	0.20	-	-	-	-

* time spacing off

Table 27. PAN concentrations at the University of Calgary, 1981 February.

Time	Day 1	2	3	4	5	6	7	8	9	10
0800	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	0.00
0820	-	0.00	-	-	-	-	-	-	-	-
0900	-	0.00	-	0.00	0.00	-	-	-	0.00	0.00
0920	-	-	0.00	-	-	-	-	-	-	-
0930	-	-	-	-	-	0.00	-	-	-	-
1000	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	0.11
1100	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	<.09
1140	-	-	0.00	-	-	-	-	-	-	-
1200	-	0.00	-	0.00	0.00	0.00	-	-	-	0.00
1300	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	0.06
1400	-	<.09	<.09	0.00	<.09	<.09	-	-	-	0.06
1500	-	<.09	<.09	0.00	0.09	0.00	-	-	0.00	<.09
1600	-	0.09	0.17	0.00	0.09	0.00	-	-	-	<.09
1630	-	-	0.13	-	-	-	-	-	-	-
1640	-	-	0.13	-	-	-	-	-	-	-
1650	-	-	-	-	0.11	-	-	-	-	-
1700	-	-	0.15	-	-	-	-	-	-	-
1730	-	-	0.45	-	-	-	-	-	-	-
1740	-	-	0.41	-	-	-	-	-	-	-
1800	-	-	0.39	-	-	-	-	-	-	-
1820	-	-	0.32	-	-	-	-	-	-	-
1830	-	-	0.37	-	-	-	-	-	-	-

continued...

Table 27. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	0.11	0.17	-	-	0.00	0.00	-	-	-
0820	-	-	-	-	-	-	-	0.00	-	-
0900	0.11	0.09	0.21	-	-	0.00	0.00	-	0.00	0.00
0930	-	-	0.17	-	-	-	-	-	-	-
1000	0.15	0.11	0.15	-	-	0.00	0.00	0.00	-	0.00
1100	0.17	0.13	0.21	-	-	0.00	0.00	0.00	-	0.00
1120	0.24	-	-	-	-	-	-	-	-	-
1130	-	-	0.21	-	-	-	-	-	-	-
1140	0.26	-	-	-	-	-	-	-	-	-
1200	0.26	0.13	0.17	-	-	0.00	0.00	0.00	-	0.00
1220	0.28	-	-	-	-	-	-	-	-	-
1240	0.30	-	-	-	-	-	-	-	-	-
1300	0.45	0.19	0.21	-	-	<.09	<.09	0.00	0.00	0.00
1330	0.43	-	-	-	-	-	-	-	-	-
1340	0.45	-	-	-	-	-	-	-	-	-
1350	0.39	-	-	-	-	-	-	-	-	-
1400	0.39	0.21	-	-	-	0.09	0.00	0.00	0.00	0.00
1410	0.45	-	0.28	-	-	-	-	-	-	-
1420	0.47	-	0.32	-	-	-	-	-	-	-
1430	-	-	0.39	-	-	-	-	-	-	-
1440	0.21	0.21	-	-	-	-	-	-	-	-
1450	-	-	0.37	-	-	-	-	-	-	-
1500	0.09	0.24	0.15	-	-	<.09	<.09	0.00	0.00	0.00
1530	0.09	-	-	-	-	-	-	-	-	-
1600	0.09	0.30	<.09	<.09	-	<.09	<.09	0.00	0.00	0.00
1630	0.09	-	-	-	-	-	-	-	-	-
1650	-	0.24	-	-	-	-	-	-	-	-
1750	-	0.24	-	-	-	-	-	-	-	-

continued...

Table 27. Concluded.

Time	Day 21	22	23	24	25	26	27	28
0800	-	-	0.00	0.00	0.00	0.00	0.00	-
0900	-	-	0.00	<.09	<.09	0.00	0.00	-
1000	-	-	0.00	0.00	0.00	0.00	0.00	-
1100	-	-	0.00	<.09	<.09	0.00	0.00	-
1200	-	-	0.00	<.09	<.09	0.00	0.00	-
1300	-	-	0.00	<.09	<.09	0.00	0.15	-
1330	-	-	-	-	-	-	0.49	-
1350	-	-	-	-	-	-	0.97	-
1400	-	-	0.00	0.09	0.00	0.00	0.77	-
1420	-	-	-	-	-	-	0.64	-
1440	-	-	-	-	-	-	0.43	-
1450	-	-	-	-	-	-	0.32	-
1500	-	-	0.00	<.09	<.09	<.09	0.34	-
1530	-	-	-	-	-	-	0.24	-
1600	-	-	-	<.09	<.09	<.09	0.21	-
1620	-	-	0.00	-	-	-	-	-
1630	-	-	-	-	-	-	0.21	-

Table 28. PAN concentrations at the University of Calgary, 1981 March

Time	Day 1	2	3	4	5	6	7	8	9	10
0800	-	0.00	0.00	-	-	-	-	-	-	-
0830	-	-	-	0.00	-	0.00	-	-	0.00	0.00
0900	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	-
0920	-	-	-	-	-	-	-	-	-	0.00
1000	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	0.00
1100	-	0.00	0.00	0.00	0.00	0.00	-	-	0.00	0.00
1200	-	0.00	0.21	0.00	0.00	0.00	-	-	-	0.00
1220	-	-	0.24	-	-	-	-	-	-	-
1240	-	-	0.62	-	-	-	-	-	-	-
1250	-	-	1.14	-	-	-	-	-	-	-
1300	-	0.00	1.16	0.17	0.00	<.09	<.09	-	0.00	<.09
1310	-	-	1.03	-	-	-	-	-	-	-
1320	-	-	0.84	0.13	-	-	-	-	-	-
1330	-	-	0.62	-	-	-	-	-	-	-
1340	-	-	0.49	-	-	-	-	-	-	-
1350	-	-	0.83	-	-	-	-	-	-	-
1400	-	0.00	0.17	0.15	0.00	<.09	<.09	-	0.00	<.09
1410	-	-	0.09	-	-	-	-	-	-	-
1500	-	0.00	<.09	<.09	<.09	0.00	-	-	0.00	0.00
1600	-	0.00	0.09	<.09	<.09	0.00	-	-	0.00	0.00
1630	-	-	<.09	<.09	-	-	-	-	-	-

continued...

Table 28. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0830	0.00	0.00	-	-	-	0.00	-	-	-	-
0900	0.00	0.13	-	-	-	0.00	0.00	-	-	-
0930	0.00	0.17	0.15	-	-	-	-	-	-	-
1000	0.00	0.30	0.15	-	-	0.00	0.00	-	-	-
1010	-	0.30	-	-	-	-	-	-	-	-
1020	-	0.41	-	-	-	-	-	-	-	-
1030	-	0.21	-	-	-	-	-	-	-	-
1040	-	0.21	-	-	-	-	-	-	-	-
1100	0.00	0.19	0.19	-	-	-	0.00	-	-	-
1120	-	0.15	-	-	-	-	-	-	-	-
1130	-	-	0.17	-	-	-	-	-	-	-
1140	-	0.13	0.17	-	-	-	-	-	-	-
1200	0.17	0.17	0.15	-	-	-	0.00	-	-	-
1220	0.19	0.21	-	-	-	-	-	-	-	-
1240	0.39	-	0.13	-	-	-	-	-	-	-
1250	0.45	-	-	-	-	-	-	-	-	-
1300	0.32	0.17	0.15	-	-	0.15	0.00	-	-	-
1310	0.43	-	-	-	-	-	-	-	-	-
1320	0.43	-	-	-	-	-	-	-	-	-
1330	0.43	-	-	-	-	-	-	-	-	-
1340	0.32	-	0.09	-	-	-	-	-	-	-
1350	0.30	-	-	-	-	-	-	-	-	-
1400	-	-	0.13	-	-	-	0.00	-	-	-
1410	-	0.17	-	-	-	0.15	-	-	-	-
1420	0.34	-	-	-	-	-	-	-	-	-
1430	0.21	-	-	-	-	-	-	-	-	-
1500	0.26	0.17	0.17	-	-	0.15	0.00	-	-	-
1540	0.24	-	0.19	-	-	-	-	-	-	-
1600	0.21	0.19	0.24	-	-	<.09	<.09	-	-	-
1620	-	-	0.15	-	-	-	-	-	-	-
1630	<.09	<.09	-	-	-	-	-	-	-	-
1640	-	-	0.11	-	-	-	-	-	-	-

continued...

Table 28. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0800	-	-	0.11	<.09	<.09	<.09	<.09	<.09	-	-	<.09
0830	-	-	-	-	0.13	-	<.09	<.09	-	-	-
0900	-	-	0.11	<.09	<.09	-	<.09	<.09	-	-	0.00
0930	-	-	-	-	0.21	<.09	<.09	-	-	<.09	<.09
1000	-	-	0.13	<.09	<.09	-	0.15	-	-	<.09	<.09
1020	-	-	-	-	-	-	0.09	-	-	-	-
1040	-	-	-	-	0.17	-	-	-	-	-	-
1100	-	-	0.13	<.09	0.13	-	-	-	-	<.09	<.09
1130	-	-	-	-	0.13	-	-	-	-	-	-
1140	-	-	-	-	-	-	-	-	-	-	<.09
1200	-	-	0.13	<.09	0.11	<.09	-	-	-	<.09	-
1230	-	-	-	-	0.09	-	-	-	-	-	-
1300	-	-	0.17	0.09	0.09	-	-	-	-	<.09	<.09
1400	-	-	0.15	0.15	<.09	<.09	<.09	-	-	<.09	<.09
1500	-	-	0.09	0.17	<.09	<.09	<.09	-	-	-	0.09
1520	-	-	-	0.26	-	-	-	-	-	-	-
1540	-	-	-	0.26	-	-	-	-	-	-	-
1600	-	-	0.13	0.21	<.09	<.09	<.09	-	-	<.09	<.09
1620	-	-	-	0.24	-	-	-	-	-	-	-
1630	-	-	-	0.17	-	-	-	-	-	-	-
1650	-	-	-	0.19	-	-	-	-	-	-	-
1700	-	-	0.19	-	-	-	-	-	-	-	-
1720	-	-	-	0.17	-	-	-	-	-	-	-
1740	-	-	-	0.17	-	-	-	-	-	-	-
1800	-	-	-	0.15	-	-	-	-	-	-	-

Table 29. PAN concentrations at the University of Calgary, 1981 April.

Time	Day 1	2	3	4	5	6	7	8	9	10
0800	0.00	-	-	-	-	-	-	-	-	-
0810	-	-	-	-	-	-	-	-	-	<.18
0830	-	0.18	-	-	-	-	-	-	-	-
0840	-	-	-	-	-	-	<.18	<.18	-	-
0900	0.00	0.18	<.18	<.18	-	-	<.18	<.18	<.18	<.18
1000	<.18	<.18	<.18	<.18	-	-	<.18	<.18	-	<.18
1100	<.18	<.18	<.18	-	-	-	<.18	<.18	-	0.18
1140	-	-	-	-	-	-	<.18	<.18	-	-
1200	<.18	<.18	<.18	-	-	-	-	0.18	<.18	<.18
1300	<.18	-	-	-	-	-	<.18	0.18	0.23	-
1400	<.18	<.18	<.18	<.18	-	-	<.18	<.18	0.18	-
1420	-	-	-	-	-	-	-	-	-	0.27
1430	-	-	-	-	-	-	-	-	-	0.27
1500	<.18	<.18	<.18	<.18	-	-	<.18	<.18	<.18	<.18
1540	-	-	-	-	-	-	-	-	-	0.22
1600	<.18	<.18	<.18	<.18	-	-	0.18	<.18	<.18	<.18
1620	-	-	-	-	-	-	-	-	-	0.22
1650	-	-	-	-	-	-	-	-	-	0.22

continued...

Table 29. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	-	-	-	0.00	0.13	-	-	-	-
0830	-	-	-	0.31	0.13	-	-	-	-	0.18
0840	-	-	0.18	-	-	-	-	-	-	-
0900	-	-	-	0.45	<.18	<.18	-	<.18	-	<.18
0910	-	-	0.18	-	-	-	-	-	-	-
0930	-	-	-	0.27	-	-	-	-	-	-
1000	-	-	0.13	0.31	0.13	<.18	<.18	-	-	<.18
1030	-	-	-	0.27	-	-	-	-	-	-
1100	-	-	0.27	0.31	0.13	<.18	<.18	-	-	<.18
1130	-	-	-	0.18	-	-	-	-	-	-
1200	-	-	0.22	0.18	0.13	<.18	<.18	-	-	0.13
1230	-	-	-	0.13	-	-	-	-	-	-
1300	-	-	0.22	0.13	0.45	<.18	<.18	-	-	<.18
1320	-	-	-	-	1.08	-	-	-	-	-
1330	-	-	0.18	0.13	1.03	-	-	-	-	-
1340	-	-	-	-	0.94	-	-	-	-	-
1350	-	-	-	-	0.63	-	-	-	-	-
1400	-	-	0.18	0.13	0.27	<.18	<.18	-	-	<.18
1430	-	-	0.27	0.18	0.31	-	-	-	-	-
1500	-	-	0.22	0.31	0.31	0.00	-	-	-	0.00
1530	-	-	-	0.36	0.27	-	-	-	-	-
1600	-	-	0.22	0.36	0.31	0.00	-	-	-	0.22
1620	-	-	-	-	0.27	-	-	-	-	-
1630	-	-	-	0.36	0.27	-	-	-	-	-
1700	-	-	-	0.41	-	-	-	-	-	-
1730	-	-	-	0.22	0.18	-	-	-	-	-

continued...

Table 29. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30
0800	-	-	0.22	0.00	-	-	0.00	-	0.13	0.27
0810	-	-	-	-	-	-	-	0.13	-	-
0830	<.18	<.18	0.18	-	-	-	0.13	-	-	0.22
0840	-	0.22	-	-	-	-	-	-	-	-
0900	<.18	<.18	0.00	0.00	-	-	0.13	0.13	0.13	0.22
0930	-	0.27	0.00	-	-	-	-	-	-	0.22
1000	0.13	0.36	0.00	0.00	-	-	0.18	<.18	<.18	0.22
1030	-	0.27	0.00	-	-	-	-	-	-	0.27
1100	<.18	<.18	0.00	0.00	-	-	0.18	<.18	<.18	0.22
1120	-	-	-	-	-	-	-	0.36	-	-
1130	-	0.13	-	-	-	-	0.13	-	0.27	0.22
1140	-	-	0.00	<.18	<.18	-	-	-	0.31	-
1200	0.13	0.13	-	-	-	-	0.13	0.13	0.22	0.27
1220	-	-	-	-	-	-	-	0.22	-	-
1240	-	-	-	-	-	-	-	0.22	-	-
1300	0.22	0.13	0.00	0.13	-	-	0.22	<.18	<.18	0.27
1330	-	-	-	-	-	-	-	-	-	0.22
1340	-	-	-	-	-	-	-	-	0.22	-
1400	0.18	<.18	<.18	<.18	<.18	-	0.45	<.18	<.18	0.22
1420	-	-	-	-	-	-	0.31	-	0.22	-
1440	-	-	-	-	-	-	0.31	-	0.18	-
1500	0.18	0.00	0.00	0.18	-	-	0.45	0.13	0.18	0.18
1520	-	-	-	-	-	-	0.40	-	-	-
1530	-	-	-	-	-	-	-	-	0.22	-
1540	-	-	-	-	-	-	0.36	-	-	0.22
1550	-	-	-	-	-	-	-	-	0.18	-
1600	0.22	0.00	0.00	0.18	-	-	0.31	0.13	0.18	0.18
1620	-	-	-	-	-	-	0.31	-	0.18	-
1630	-	-	-	-	-	-	-	-	-	0.22
1640	-	-	-	-	-	0.22	-	-	-	-

Table 30. PAN concentrations at the University of Calgary, 1981 May.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	-	-	-	-	-	-	-	-	0.17
0830	-	-	-	-	-	-	-	-	-	0.22
0900	-	-	-	-	-	-	-	-	-	0.25
0930	-	-	-	-	-	-	-	-	-	0.27
1000	-	-	-	-	-	-	-	-	-	0.41
1030	-	-	-	-	-	-	-	-	-	0.48
1100	-	-	-	-	-	-	-	-	-	0.45
1130	-	-	-	-	-	-	-	-	-	0.51
1200	-	-	-	-	-	-	-	-	-	0.61
1300	-	-	-	-	0.39	-	-	-	-	-
1315	-	-	-	-	0.37	-	-	-	-	-
1330	-	-	-	-	0.36	-	-	-	-	-
1345	-	-	-	-	0.36	-	-	-	-	-
1400	-	-	-	-	0.50	-	-	-	-	0.44
1430	-	-	-	-	0.42	-	-	-	-	0.54
1500	-	-	-	-	0.58	-	-	-	-	0.51
1530	-	-	-	-	-	-	-	-	-	0.44
1600	-	-	-	-	0.53	-	-	-	-	0.45
1615	-	-	-	-	-	-	-	-	-	0.30
1630	-	-	-	-	0.42	-	-	-	-	0.39
1700	-	-	-	-	0.45	-	-	-	-	0.33
1715	-	-	-	-	0.50	-	-	-	-	-
1730	-	-	-	-	0.44	-	-	-	-	-
1745	-	-	-	-	0.42	-	-	-	-	-

continued...

Table 30. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0800	-	0.23	-	-	0.20	0.20	0.00	0.00	0.00	-	-
0830	-	-	-	-	0.22	0.20	-	-	-	-	-
0900	-	0.31	-	-	0.33	0.27	0.00	0.00	0.00	-	-
0930	-	-	-	-	0.47	-	-	-	-	-	-
0945	-	-	-	-	0.53	-	-	-	-	-	-
1000	0.34	0.00	-	-	0.42	0.27	0.42	0.00	0.51	-	-
1030	0.23	-	0.31	0.25	-	-	-	-	-	-	-
1045	-	-	-	-	0.23	-	-	-	-	-	-
1100	0.19	-	-	-	0.37	0.20	0.36	0.00	0.49	-	-
1130	-	-	-	-	0.31	0.23	-	-	0.37	-	-
1200	0.27	-	0.23	-	0.23	0.33	0.34	0.00	0.45	-	-
1300	0.42	-	-	-	0.34	0.28	0.28	0.00	0.73	-	-
1330	-	-	-	-	0.34	0.23	0.20	-	0.64	-	-
1345	-	-	-	-	-	-	-	-	0.59	-	-
1400	0.36	-	-	-	-	0.25	0.28	0.00	0.62	-	-
1430	-	-	-	-	-	-	0.17	-	0.60	-	-
1445	-	-	-	-	-	-	-	-	0.59	-	-
1500	0.30	-	-	-	0.30	-	0.30	0.00	0.62	-	-
1530	-	-	-	-	0.27	-	0.32	-	0.65	-	-
1545	-	-	-	-	0.30	-	0.26	-	-	-	-
1600	0.28	-	-	-	0.30	0.27	0.34	0.00	0.64	-	-
1630	-	-	-	-	-	0.30	0.37	-	0.54	-	-
1645	-	-	-	-	-	-	0.36	-	0.56	-	-
1700	-	-	-	-	-	-	0.28	0.00	0.55	-	-

Table 31. PAN concentrations at the University of Calgary, 1981 June.

Time	Day 1	2	3	4	5	6	7	8	9	10
0815	-	0.17	-	-	-	-	-	0.22	-	-
0830	-	-	0.17	-	0.19	-	-	0.24	-	-
0845	-	-	-	-	-	-	-	-	0.16	0.20
0900	-	-	0.20	-	0.19	-	-	0.20	0.19	-
0915	-	0.24	-	0.16	-	-	-	-	-	-
0930	-	0.36	-	-	-	-	-	-	0.19	0.22
0945	-	-	-	-	-	-	-	-	-	0.19
1000	0.20	0.39	0.19	0.16	0.16	-	-	0.24	0.22	0.19
1030	-	0.36	-	-	-	-	-	-	0.17	0.20
1045	-	0.30	-	-	-	-	-	-	-	-
1100	0.22	0.20	-	-	0.17	-	-	0.22	0.24	0.20
1115	0.20	-	0.24	0.17	-	-	-	0.24	-	-
1130	0.20	0.17	-	-	-	-	-	0.27	0.20	0.20
1200	-	0.19	0.24	0.19	-	-	-	-	0.24	0.19
1230	-	0.20	-	0.17	-	-	-	-	-	-
1300	0.24	0.24	0.33	0.19	0.22	-	-	0.17	-	0.22
1315	-	-	-	-	-	-	-	-	0.27	-
1330	-	0.27	-	-	-	-	-	0.17	-	-
1345	-	-	-	-	-	-	-	-	-	0.24
1400	0.34	0.30	0.34	0.24	0.20	-	-	0.16	0.31	-
1415	-	-	-	0.24	-	-	-	-	-	0.24
1430	-	0.36	-	-	-	-	-	-	0.24	-
1445	-	-	-	-	-	-	-	0.24	-	-
1500	0.34	0.59	0.33	0.24	0.24	-	-	0.24	0.22	0.22
1515	-	0.41	-	-	-	-	-	-	-	-
1530	0.36	0.41	-	-	-	-	-	-	0.27	0.28
1545	-	0.36	-	-	-	-	-	0.31	-	-
1600	0.37	-	0.39	0.20	0.24	-	-	-	-	-
1615	-	-	-	0.19	-	-	-	0.30	-	-
1630	0.37	0.36	0.39	0.19	0.27	-	-	-	0.27	0.28
1700	-	0.36	-	-	-	-	-	-	-	-

continued...

Table 31. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	-	-	-	0.31	0.16	-	-	0.00	-
0815	-	0.19	-	-	-	-	-	-	-	-
0830	-	0.34	-	-	-	-	0.21	-	-	-
0900	-	0.21	-	-	-	-	0.24	-	0.16	-
0915	-	0.21	-	-	-	0.24	-	-	-	-
0930	-	-	-	-	0.24	-	-	-	0.00	-
1000	-	0.24	-	-	-	0.16	0.26	-	-	-
1015	-	-	-	-	-	-	-	-	-	-
1030	-	0.24	-	-	-	-	-	-	-	-
1100	-	0.24	-	-	-	0.26	0.26	-	-	-
1115	-	-	-	-	-	-	-	-	0.21	-
1130	-	0.24	-	-	-	-	-	-	-	-
1200	-	-	-	-	-	0.24	-	-	-	-
1300	-	0.22	-	-	-	0.24	0.24	-	-	-
1315	-	-	-	-	0.34	-	-	-	-	-
1400	-	-	-	-	0.38	0.26	0.21	-	-	-
1500	-	-	-	-	0.31	0.24	0.24	-	-	-
1600	-	-	-	-	0.36	0.21	0.21	-	-	-
1700	-	-	-	-	0.43	-	-	-	-	-

continued...

Table 31. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30
0800	-	-	0.24	-	-	0.21	-	-	-	-
0815	-	-	-	0.21	-	-	-	-	-	-
0830	-	-	-	-	0.19	0.34	-	-	-	-
0845	-	-	0.34	-	-	-	-	-	-	-
0900	-	-	-	0.00	-	0.38	-	-	0.24	0.00
0915	-	0.00	0.43	-	-	-	-	-	-	-
0930	-	-	-	-	-	-	-	-	0.19	-
0945	-	-	-	-	0.31	-	-	-	0.19	-
1000	-	0.24	0.24	-	-	-	-	-	-	0.26
1015	-	-	-	-	0.34	-	-	-	-	-
1030	-	-	-	-	-	0.49	-	-	0.16	-
1045	-	-	-	-	-	0.51	-	-	-	-
1100	-	0.16	0.21	0.16	0.34	0.51	-	-	0.16	-
1115	-	-	-	-	-	0.49	-	-	-	-
1130	-	-	-	-	0.31	0.46	-	-	-	0.41
1145	-	-	0.19	-	-	-	-	-	-	-
1200	-	0.21	-	0.26	0.31	-	-	-	-	-
1300	-	-	-	0.31	0.36	-	-	-	-	-
1315	-	-	0.26	-	-	0.43	-	-	-	-
1330	-	0.21	-	-	0.31	-	-	-	0.00	-
1345	-	-	0.21	-	-	0.59	-	-	-	-
1400	-	-	0.26	0.38	-	0.58	-	-	0.00	0.21
1415	-	-	0.26	-	-	-	-	-	-	-
1430	-	-	0.24	-	0.43	0.58	-	-	-	-
1445	-	0.26	-	-	-	0.56	-	-	-	-
1500	-	-	0.21	0.26	0.36	0.58	-	-	0.00	0.24
1530	-	-	0.21	-	-	0.56	-	-	-	-
1600	-	0.24	0.24	0.21	0.36	0.60	-	-	0.00	0.24
1615	-	-	0.21	-	-	-	-	-	-	-
1630	-	0.21	0.26	-	0.31	-	-	-	-	-
1700	-	-	0.29	-	0.26	-	-	-	-	0.16
1715	-	-	0.26	0.00	-	-	-	-	-	-
*1915	-	-	0.19	-	-	-	-	-	-	-
*1945	-	-	0.19	-	-	0.00	-	-	-	-
*2030	-	-	0.24	-	-	-	-	-	-	-

* time spacer off

Table 32. PAN concentrations at the University of Calgary, 1981 July.

Time	Day 1	2	3	4	5	6	7	8	9	10
0800	-	-	-	-	-	-	-	-	0.00	0.24
0815	-	0.00	-	-	-	-	-	-	-	-
0830	-	-	-	-	-	0.00	0.00	0.00	0.00	-
0845	-	-	-	-	-	-	-	-	0.00	-
0900	-	0.16	0.00	-	-	0.24	0.00	-	0.24	0.31
0915	-	-	-	-	-	-	-	0.19	-	-
0930	-	-	-	-	-	-	-	-	0.24	0.26
0945	-	-	-	-	-	-	-	-	0.24	-
1000	-	0.16	-	-	-	0.24	0.00	-	0.26	-
1015	-	-	0.16	-	-	-	-	-	-	-
1030	-	-	-	-	-	0.19	0.19	0.19	0.21	-
1045	-	-	-	-	-	-	-	-	-	0.29
1100	-	0.24	0.21	-	-	0.21	0.19	0.19	0.21	-
1115	-	-	-	-	-	-	-	-	-	0.29
1145	-	-	-	-	-	-	-	-	0.26	-
1200	-	0.16	0.36	-	-	0.21	0.16	0.00	0.26	0.29
1230	-	-	0.51	-	-	-	-	-	-	-
1245	-	-	0.53	-	-	-	-	-	-	-
1300	-	-	0.60	-	-	0.29	-	0.19	0.29	0.33
1315	-	-	0.60	-	-	-	0.16	-	-	-
1330	-	-	0.65	-	-	-	-	-	-	-
1345	-	-	0.51	-	-	-	-	-	-	-
1400	-	0.26	0.75	-	-	0.26	-	0.00	0.31	0.31
1415	-	-	0.48	-	-	-	0.16	-	-	-
1430	-	-	0.46	-	-	-	-	-	0.33	-
1445	-	-	0.38	-	-	-	-	-	0.36	-
1500	-	0.21	0.38	-	-	0.26	-	-	-	0.36
1515	-	-	-	-	-	-	0.16	0.24	0.26	-
1530	-	0.29	-	-	-	-	-	0.19	-	-
1545	-	-	-	-	-	-	-	0.24	-	-
1600	-	0.26	-	-	-	0.29	0.16	-	0.33	0.33
1615	-	-	0.24	-	-	-	-	-	-	-
1630	-	-	-	-	-	0.21	-	-	0.29	-
1700	-	-	-	-	-	-	0.16	-	-	-
1800	-	0.24	-	-	-	-	-	-	-	-

continued...

Table 32. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	-	0.00	0.00	-	-	-	-	-	-
0815	-	-	-	0.24	-	-	-	-	-	0.00
0830	-	-	0.26	-	0.00	-	-	-	-	-
0900	-	-	0.24	-	-	-	-	-	-	0.24
0915	-	-	-	-	-	0.21	-	-	-	-
0930	-	-	0.31	0.33	-	-	-	-	-	-
0945	-	-	-	-	0.21	-	-	-	-	-
1000	-	-	0.33	0.38	-	-	-	-	-	-
1015	-	-	-	-	-	0.21	-	-	-	0.33
1030	-	-	0.26	-	-	-	-	-	-	-
1045	-	-	-	-	0.24	-	-	-	-	-
1100	-	-	0.24	0.26	-	-	-	-	-	0.26
1115	-	-	-	-	-	0.24	0.63	-	-	-
1130	-	-	0.29	-	-	-	0.53	-	-	-
1145	-	-	-	-	-	0.24	-	-	-	-
1200	-	-	0.29	-	0.29	-	0.53	-	-	0.29
1300	-	-	-	0.34	0.26	0.34	-	-	-	0.34
1315	-	-	0.24	-	-	-	0.53	-	-	-
1345	-	-	-	0.26	-	-	-	-	-	-
1400	-	-	0.31	-	0.33	0.36	0.53	-	-	0.34
1415	-	-	-	-	-	-	0.46	-	-	-
1430	-	-	0.31	-	-	-	-	-	-	-
1445	-	-	-	0.33	-	-	0.41	-	-	-
1500	-	-	-	0.33	0.33	-	0.31	-	-	0.33
1515	-	-	-	-	-	-	0.36	-	-	-
1530	-	-	0.51	-	0.33	-	0.36	-	-	-
1600	-	-	0.68	-	0.26	0.33	-	-	-	0.38
1630	-	-	0.48	-	-	-	-	-	-	-

continued...

Table 32. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0800	0.26	-	-	-	-	-	-	0.00	0.21	0.21	-
0815	-	-	-	-	-	-	0.00	-	-	-	0.00
0830	-	-	-	-	-	-	-	0.00	0.29	-	-
0900	0.29	0.00	-	-	-	-	0.21	-	0.33	-	0.46
0915	-	-	0.00	-	-	-	-	-	-	-	-
0930	-	-	-	-	-	-	-	0.24	-	0.00	0.43
1000	0.21	0.00	0.19	-	-	-	0.19	0.24	0.33	-	-
1015	-	-	-	-	-	-	-	-	-	0.00	0.63
1030	-	-	-	0.19	-	-	-	-	-	-	1.17
1045	-	-	-	-	-	-	-	-	-	-	0.87
1100	0.24	0.21	0.16	-	-	-	-	-	0.38	0.00	0.63
1115	-	-	-	-	-	-	0.21	0.31	-	-	0.58
1130	-	-	0.19	-	-	-	-	-	0.43	-	0.58
1145	-	-	-	-	-	-	-	-	-	-	0.73
1200	0.24	0.21	-	0.00	-	-	0.24	0.33	-	-	0.58
1215	-	-	-	-	-	-	-	-	-	-	1.02
1230	-	-	-	-	-	-	-	-	-	-	1.02
1245	-	-	-	-	-	-	-	-	-	-	0.87
1300	0.29	-	0.24	-	-	-	0.31	0.48	-	-	0.78
1315	-	-	-	-	-	-	-	-	-	-	0.78
1330	-	-	-	-	-	-	-	0.51	0.82	-	0.60
1400	0.29	-	0.24	-	-	-	-	0.53	0.95	-	0.56
1415	-	0.26	-	-	-	-	0.53	-	-	-	0.41
1430	-	-	-	-	-	-	0.43	0.65	1.31	-	0.41
1445	-	-	-	-	-	-	-	-	-	-	0.41
1500	0.33	0.21	0.24	-	-	-	0.53	0.58	1.36	0.29	0.36
1530	-	-	-	-	-	-	-	0.53	2.00	-	0.38
1545	-	-	0.29	0.21	-	-	1.63	-	-	-	-
1600	0.29	0.24	-	-	-	-	1.66	-	1.90	0.33	0.38
1615	-	-	-	-	-	-	1.51	0.43	1.85	-	0.38
1630	-	-	-	-	-	-	0.92	0.46	0.97	0.29	-
1700	-	-	-	-	-	-	-	-	-	-	0.38
1715	-	-	-	-	-	-	0.56	-	-	0.26	-
1815	-	-	-	-	-	-	-	-	0.26	-	-
1830	-	-	-	-	-	-	-	0.26	-	-	-
1845	-	-	-	-	-	-	0.48	-	-	-	-
1915	-	-	-	-	-	-	-	-	0.24	-	-

Table 33. PAN concentrations at the University of Calgary, 1981 August.

Time	Day 1	2	3	4	5	6	7	8	9	10
0800	-	-	-	-	-	0.00	0.00	-	-	0.00
0815	-	-	-	-	-	-	-	-	-	0.00
0900	-	-	-	0.00	0.00	0.12	0.05	-	-	0.12
0945	-	-	-	0.20	-	-	-	-	-	-
1000	-	-	-	-	0.07	-	-	-	-	0.12
1030	-	-	-	-	-	-	0.32	-	-	-
1100	-	-	-	-	0.15	0.22	0.47	-	-	-
1130	-	-	-	-	-	0.35	-	-	-	-
1145	-	-	-	0.17	-	-	-	-	-	-
1200	-	-	-	0.20	0.20	0.40	0.70	-	-	-
1230	-	-	-	-	-	0.60	-	-	-	-
1300	-	-	-	-	0.37	-	-	-	-	-
1315	-	-	-	0.17	-	1.40	0.60	-	-	-
1330	-	-	-	0.22	0.42	-	-	-	-	0.27
1345	-	-	-	-	-	2.10	-	-	-	-
1400	-	-	-	-	0.42	1.62	-	-	-	-
1415	-	-	-	0.17	-	-	-	-	-	-
1430	-	-	-	-	0.57	1.80	0.70	-	-	-
1500	-	-	-	-	0.65	1.20	-	-	-	0.12
1530	-	-	-	-	0.65	0.90	-	-	-	-
1545	-	-	-	-	-	-	0.57	-	-	-
1600	-	-	-	-	1.02	-	-	-	-	0.17
1615	-	-	-	-	-	0.52	-	-	-	-
1630	-	-	-	-	2.12	0.55	-	-	-	-
1645	-	-	-	-	2.15	-	-	-	-	-
1700	-	-	-	-	2.12	-	-	-	-	-
1715	-	-	-	-	1.75	-	-	-	-	-
1730	-	-	-	-	1.40	-	-	-	-	-
1745	-	-	-	-	0.97	-	-	-	-	-
1800	-	-	-	-	0.90	-	-	-	-	-
1815	-	-	-	-	0.82	-	-	-	-	-
1830	-	-	-	-	0.72	-	-	-	-	-
1900	-	-	-	-	0.87	-	-	-	-	-
1930	-	-	-	-	0.77	-	-	-	-	-
*2030	-	-	-	-	0.97	-	-	-	-	-
*2200	-	-	-	-	0.77	-	-	-	-	-

* time spacer off

continued...

Table 33. Continued.

Time	Day 11	12	13	14	15	16	17	18	19	20
0800	-	0.07	-	-	-	-	-	-	0.00	-
0815	0.07	-	-	-	-	-	-	-	-	-
0830	-	-	-	0.20	-	-	-	-	-	-
0845	-	-	-	-	-	-	-	-	0.05	-
0900	-	0.15	0.37	-	-	-	-	-	0.05	-
0915	-	-	-	-	-	-	-	-	-	0.05
0930	0.12	0.15	0.52	0.30	-	-	-	-	-	-
1000	0.32	0.17	0.52	0.25	-	-	0.10	-	0.05	0.12
1030	0.40	0.20	0.57	0.32	-	-	-	-	-	-
1100	-	-	0.62	0.22	-	-	0.20	-	0.15	0.07
1130	0.67	0.35	0.57	-	-	-	0.20	-	-	-
1145	-	-	-	0.35	-	-	-	-	-	-
1200	0.77	-	0.60	-	-	-	-	-	0.30	0.15
1230	-	-	-	0.50	-	-	-	-	-	-
1245	1.25	-	-	-	-	-	-	-	-	-
1300	-	-	0.65	0.72	-	-	0.62	-	1.40	-
1315	1.95	-	-	-	-	-	-	-	-	-
1330	-	-	0.60	0.72	-	-	0.45	0.30	-	-
1345	-	0.07	-	-	-	-	-	-	-	-
1400	0.82	-	0.57	-	-	-	0.15	0.50	-	-
1415	-	-	-	1.45	-	-	0.17	-	0.35	-
1430	0.65	0.12	-	2.27	-	-	0.12	-	-	-
1445	-	-	0.52	-	-	-	-	-	0.25	-
1500	-	-	0.57	2.35	-	-	0.17	0.77	-	-
1515	0.57	-	-	2.15	-	-	-	-	0.07	-
1530	-	0.15	-	-	-	-	0.12	0.50	-	-
1545	-	-	0.55	1.52	-	-	-	-	-	-
1600	0.65	-	-	-	-	-	0.15	0.47	-	-
1615	-	0.15	-	-	-	-	0.12	-	0.12	-
1630	-	-	0.50	1.17	-	-	-	0.42	-	-
1700	-	-	-	0.67	-	-	-	-	-	-

continued...

Table 33 Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0815	-	-	-	-	0.15	0.07	0.07	-	-	-	0.07
0830	0.05	-	-	-	-	-	-	-	-	-	-
0900	-	-	-	0.07	0.22	0.10	0.12	-	-	-	-
0915	-	-	-	-	-	-	-	0.17	-	-	0.05
0930	0.07	-	-	-	-	0.17	-	-	-	-	-
1000	-	-	-	0.07	0.22	0.10	0.20	-	-	0.45	-
1030	0.07	-	-	-	-	-	-	-	-	-	-
1100	-	-	-	0.32	0.35	0.55	0.15	-	-	0.55	0.07
1130	0.07	-	-	-	0.32	0.32	-	0.37	-	-	0.10
1145	-	-	-	-	-	-	0.22	-	-	-	-
1200	-	-	-	-	0.27	0.32	-	-	-	0.37	0.07
1300	-	-	-	0.17	-	0.20	0.15	-	-	-	-
1315	0.12	-	-	-	-	-	-	0.27	-	-	0.15
1330	-	-	-	-	0.25	-	-	-	-	-	-
1400	0.10	-	-	0.12	0.25	-	0.12	1.02	-	-	0.20
1430	-	-	-	-	0.20	-	-	1.57	-	-	-
1445	-	-	-	-	-	-	-	1.60	-	-	-
1500	-	-	-	0.12	0.15	-	0.07	-	-	-	0.22
1530	0.25	-	-	-	0.12	-	-	1.35	-	-	-
1600	0.35	-	-	0.15	0.17	-	-	1.15	-	-	0.42
1615	-	-	-	-	-	-	-	1.15	-	-	-
1700	-	-	-	0.12	-	-	-	-	-	-	-
1730	-	-	-	-	-	-	-	-	0.67	0.72	-
1745	-	-	-	-	-	-	-	-	0.67	0.77	-

9.3 PERCENTILE DISTRIBUTION OF CALGARY PAN MEASUREMENTS

9.3.1 Percentile Distribution of PAN Measurements Made at the University of Calgary between 1980 December and 1981 August

Table 34. The percentile distribution of PAN measurements made at the University of Calgary between 1980 December and 1981 August.

Range	n	Percentile
1980 December		
< 0.5	248	100.00
0.51 to 1.00	0	0.00
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 0.29		
Mean Value = 0.067		
1981 January		
< 0.5	357	94.20
0.51 to 1.00	6	1.58
1.01 to 1.50	8	2.11
1.51 to 2.00	6	1.58
2.01 to 3.00	2	0.53
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 2.3		
Mean Value = 0.164		
1981 February		
< 0.5	283	98.95
0.51 to 1.00	3	1.05
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 0.97		
Mean Value = 0.0634		

continued...

Table 34. Continued.

Range	n	Percentile
1981 March		
< 0.5	266	97.44
0.51 to 1.00	4	1.47
1.01 to 1.50	3	1.10
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 1.16		
Mean Value = 0.084		
1981 April		
< 0.5	286	98.62
0.51 to 1.00	2	0.69
1.01 to 1.50	2	0.69
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 1.08		
Mean Value = 0.108		
1981 May		
< 0.5	158	89.27
0.51 to 1.00	19	10.73
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 0.73		
Mean Value = 0.200		

continued...

Table 34. Concluded.

Range	n	Percentile
1981 June		
< 0.5	264	97.33
0.51 to 1.00	10	2.67
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 0.6		
Mean Value = 0.144		
1981 July		
< 0.5	349	87.69
0.51 to 1.00	38	9.55
1.01 to 1.50	5	1.26
1.51 to 2.00	6	1.51
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 2		
Mean Value = 0.221		
1981 August		
< 0.5	280	79.32
0.51 to 1.00	47	13.31
1.01 to 1.50	12	3.40
1.51 to 2.00	7	1.98
2.01 to 3.00	7	1.98
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 2.35		
Mean Value = 0.2794		

9.3.2 Percentile Distribution of PAN Measurements Made in Downtown Calgary between 1981 July and 1982 February

Table 35. The percentile distribution of PAN measurements made in downtown Calgary between 1981 July and 1982 February.

Range	n	Percentile
1981 July		
< 0.5	350	86.85
0.51 to 1.00	35	8.68
1.01 to 1.50	8	1.99
1.51 to 2.00	1	0.25
2.01 to 3.00	6	1.49
3.01 to 5.00	3	0.74
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 3.68		
Mean Value = 0.176		
1981 August		
< 0.5	926	69.26
0.51 to 1.00	233	16.77
1.01 to 1.50	104	7.49
1.51 to 2.00	33	2.38
2.01 to 3.00	40	2.88
3.01 to 5.00	14	1.01
> 5.00	3	0.22
Lowest Value = 0		
Highest Value = 6.55		
Mean Value = 0.395		
1981 September		
< 0.5	1371	91.58
0.51 to 1.00	93	6.21
1.01 to 1.50	13	0.87
1.51 to 2.00	12	0.80
2.01 to 3.00	7	0.47
3.01 to 5.00	1	0.07
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 3.1		
Mean Value = 0.1014		

continued...

Table 35. Continued.

Range	n	Percentile
1981 October		
< 0.5	1187	99.00
0.51 to 1.00	11	0.92
1.01 to 1.50	1	0.08
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 0.29		
Mean Value = 0.067		
1981 November		
< 0.5	1497	99.73
0.51 to 1.00	3	0.20
1.01 to 1.50	1	0.07
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 1.25		
Mean Value = 0.0039		
1981 December		
< 0.5	1580	99.87
0.51 to 1.00	2	0.13
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 0.56		
Mean Value = 0.0021		

continued...

Table 35. Concluded.

Range	n	Percentile
1982 January		
< 0.5	1269	99.14
0.51 to 1.00	11	0.86
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 0.89		
Mean Value = 0.0077		
1982 February		
< 0.5	1254	89.64
0.51 to 1.00	139	9.94
1.01 to 1.50	3	0.21
1.51 to 2.00	3	0.21
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Lowest Value = 0		
Highest Value = 1.78		
Mean Value = 0.0090		

9.4 PAN CONCENTRATIONS, KANANASKIS

The following tables show PAN concentrations in the atmosphere at the Kananaskis Field Station measured during the period 1982 April 21 to August 31. All values in ppb.

Table 36. PAN concentrations in the Kananaskis Valley, 1982 April.

Time	Day 21	22	23	24	25	26	27	28	29	30
0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.33	0.00
0030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.33	0.39
0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.40
0130	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.50	0.00	0.40
0200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.39
0230	0.00	0.00	0.36	0.31	0.00	0.00	0.00	0.50	0.00	0.00
0300	0.00	0.00	0.37	0.00	0.44	0.00	0.00	0.47	0.00	0.38
0330	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.46	0.00	0.39
0400	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.50	0.00	0.00
0430	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.48	0.00	0.00
0500	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.49	0.00	0.00
0530	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.40	0.00	0.00
0600	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.39	0.00	0.00
0630	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.47	0.00	0.00
0700	0.00	0.00	0.36	0.00	0.37	0.00	0.00	0.47	0.00	0.00
0730	0.00	0.00	0.36	0.00	0.36	0.34	0.34	0.49	0.00	0.00
0800	0.00	0.00	0.37	0.00	0.36	0.36	0.37	0.50	0.00	0.00
0830	0.00	0.00	0.36	0.00	0.38	0.39	0.44	0.49	0.00	0.40
0900	0.00	0.00	0.37	0.33	0.40	0.41	0.44	0.49	0.00	0.41
0930	0.00	0.00	0.38	0.33	0.42	0.39	0.44	0.49	0.00	0.44
1000	0.00	0.00	0.40	0.32	0.43	0.41	0.43	0.45	0.00	0.45
1030	0.00	0.00	0.42	0.34	0.44	0.41	0.44	0.43	0.00	0.46
1100	0.00	0.00	0.00	0.34	0.44	0.39	0.42	0.39	0.00	0.46
1130	0.00	0.00	0.00	0.32	0.47	0.39	0.41	0.38	0.00	0.47
1200	0.00	0.00	0.45	0.34	0.47	0.37	0.41	0.44	0.00	0.46
1230	0.00	0.00	0.46	0.34	0.45	0.39	0.39	0.52	0.35	0.45
1300	0.00	0.00	0.47	0.33	0.44	0.38	0.40	0.48	0.35	0.45
1330	0.00	0.00	0.45	0.34	0.44	0.36	0.40	0.41	0.37	0.44
1400	0.00	0.00	0.42	0.35	0.46	0.35	0.38	0.48	0.37	0.46
1430	0.00	0.00	0.38	0.36	0.44	0.36	0.38	0.46	0.37	0.44
1500	0.00	0.00	0.38	0.36	0.44	0.35	0.40	0.00	0.37	0.46
1530	0.00	0.00	0.37	0.40	0.44	0.35	0.40	0.39	0.38	0.45
1600	0.00	0.00	0.38	0.38	0.44	0.38	0.39	0.00	0.39	0.46
1630	0.00	0.00	0.38	0.38	0.43	0.39	0.37	0.38	0.00	0.48
1700	0.00	0.00	0.38	0.38	0.43	0.39	0.40	0.00	0.38	0.49
1730	0.00	0.00	0.39	0.40	0.43	0.40	0.40	0.00	0.40	0.48
1800	0.00	0.00	0.40	0.38	0.44	0.41	0.40	0.00	0.37	0.50
1830	0.00	0.00	0.40	0.39	0.45	0.40	0.41	0.00	0.35	0.48
1900	0.00	0.00	0.40	0.38	0.44	0.00	0.41	0.00	0.37	0.50
1930	0.00	0.00	0.40	0.34	0.47	0.00	0.41	0.00	0.40	0.40
2000	0.00	0.00	0.40	0.00	0.43	0.00	0.00	0.00	0.38	0.37
2030	0.00	0.00	0.34	0.00	0.45	0.34	0.41	0.00	0.38	0.00
2100	0.00	0.00	0.38	0.00	0.34	0.00	0.40	0.31	0.38	0.00
2130	0.00	0.00	0.42	0.00	0.35	0.32	0.39	0.00	0.38	0.46
2200	0.00	0.00	0.38	0.00	0.00	0.37	0.37	0.00	0.38	-
2230	0.00	0.00	0.38	0.00	0.00	0.38	0.33	0.33	0.39	-
2300	0.00	0.00	0.34	0.00	0.00	0.38	0.40	0.33	0.39	-
2330	0.00	0.00	0.33	0.00	0.00	0.32	0.40	0.33	0.38	-

Table 37. PAN concentrations in the Kananaskis Valley, 1982 May.

Time	Day 11	12	13	14	15	16	17	18	19	20
0000	-	-	-	-	-	-	-	-	0.00	0.00
0030	-	-	-	-	-	-	-	-	0.00	0.00
0100	-	-	-	-	-	-	-	-	0.00	0.00
0130	-	-	-	-	-	-	-	-	0.00	0.00
0200	-	-	-	-	-	-	-	-	0.00	0.00
0230	-	-	-	-	-	-	-	-	0.00	0.00
0300	-	-	-	-	-	-	-	-	0.00	0.00
0330	-	-	-	-	-	-	-	-	0.00	0.00
0400	-	-	-	-	-	-	-	-	0.00	0.00
0430	-	-	-	-	-	-	-	-	0.00	0.00
0500	-	-	-	-	-	-	-	-	0.00	0.00
0530	-	-	-	-	-	-	-	-	0.00	0.00
0600	-	-	-	-	-	-	-	-	0.00	0.00
0630	-	-	-	-	-	-	-	-	0.00	0.00
0700	-	-	-	-	-	-	-	-	0.00	0.00
0730	-	-	-	-	-	-	-	-	0.00	0.00
0800	-	-	-	-	-	-	-	-	0.00	0.00
0830	-	-	-	-	-	-	-	-	0.00	0.00
0900	-	-	-	-	-	-	-	-	0.00	0.00
0930	-	-	-	-	-	-	-	-	0.00	0.00
1000	-	-	-	-	-	-	-	-	0.00	0.00
1030	-	-	-	-	-	-	-	-	0.00	0.00
1100	-	-	-	-	-	-	-	-	0.00	0.00
1130	-	-	-	-	-	-	-	-	0.00	0.00
1200	-	-	-	-	-	-	-	-	0.00	0.00
1230	-	-	-	-	-	-	-	-	0.00	0.00
1300	-	-	-	-	-	-	-	-	0.00	0.00
1330	-	-	-	-	-	-	-	-	0.00	0.00
1400	-	-	-	-	-	-	-	-	0.00	0.00
1430	-	-	-	-	-	-	-	-	0.00	0.00
1500	-	-	-	-	-	-	-	-	0.00	0.00
1530	-	-	-	-	-	-	-	-	0.00	0.00
1600	-	-	-	-	-	-	-	0.36	0.00	0.00
1630	-	-	-	-	-	-	-	0.00	0.00	0.00
1700	-	-	-	-	-	-	-	0.39	0.00	0.00
1730	-	-	-	-	-	-	-	0.36	0.00	0.00
1800	-	-	-	-	-	-	-	0.34	0.00	0.00
1830	-	-	-	-	-	-	-	0.00	0.00	0.00
1900	-	-	-	-	-	-	-	0.00	0.00	0.00
1930	-	-	-	-	-	-	-	0.00	0.00	0.00
2000	-	-	-	-	-	-	-	0.00	0.42	0.00
2030	-	-	-	-	-	-	-	0.00	0.40	0.00
2100	-	-	-	-	-	-	-	0.00	0.00	0.00
2130	-	-	-	-	-	-	-	0.00	0.00	0.00
2200	-	-	-	-	-	-	-	0.00	0.00	0.00
2230	-	-	-	-	-	-	-	0.00	0.00	0.00
2300	-	-	-	-	-	-	-	0.00	0.00	0.00
2330	-	-	-	-	-	-	-	0.00	0.00	0.00
2400	-	-	-	-	-	-	-	0.00	0.00	0.00

continued...

Table 37. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0030	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0100	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0130	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0200	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0230	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0300	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0330	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0400	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0430	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0500	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0530	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0600	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0630	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0700	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0730	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0800	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0830	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
0900	0.00	-	-	0.00	0.00	0.00	0.00	-	0.00	-	-
0930	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-
1000	-	-	-	0.00	0.38	0.00	0.00	0.00	0.00	-	0.42
1030	-	-	-	0.00	0.45	0.00	-	0.00	0.00	-	0.37
1100	-	-	-	0.00	0.49	0.00	-	0.00	0.00	-	0.41
1130	-	-	-	0.00	0.54	0.00	-	0.00	0.00	-	0.39
1200	-	-	-	0.00	0.52	0.00	-	0.00	0.00	-	0.38
1230	-	-	-	0.00	0.56	0.00	-	0.00	0.00	-	0.41
1300	-	-	-	0.00	0.57	0.00	-	0.00	0.00	-	0.46
1330	-	-	-	0.00	0.47	0.00	-	0.00	0.00	-	0.45
1400	-	-	-	0.00	0.50	0.00	-	0.00	0.00	-	0.45
1430	-	-	-	0.00	0.45	0.00	-	0.00	0.00	-	0.55
1500	-	-	-	0.00	0.50	0.00	-	0.00	0.00	-	0.53
1530	-	-	-	0.00	0.00	0.00	-	0.00	-	-	0.56
1600	-	-	-	0.00	0.00	0.00	-	0.00	-	-	0.60
1630	-	-	-	0.00	0.00	0.00	-	0.00	-	-	0.61
1700	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.73
1730	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.95
1800	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	1.22
1830	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	1.36
1900	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	1.28
1930	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.86
2000	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.73
2030	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.53
2100	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.66
2130	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.54
2200	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	0.29
2230	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-	0.00
2300	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-	0.00
2330	-	-	0.00	0.00	0.00	0.00	0.00	0.00	-	-	0.00

Table 38. PAN concentrations in the Kananaskis Valley, 1982 June.

Time	Day 1	2	3	4	5	6	7	8	9	10
0000 MDST										
0030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0100	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00
0130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00
0230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00
0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0500	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00
0530	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0600	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0630	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0700	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0800	0.00	0.00	-	0.31	0.00	0.00	0.00	0.00	0.00	0.00
0830	0.00	0.30	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00
0900	0.40	0.30	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.31
0930	0.55	0.36	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00
1000	0.60	0.36	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
1030	0.67	0.39	0.00	0.41	0.00	0.00	0.00	-	0.37	0.00
1100	0.61	0.40	0.00	0.42	0.00	0.00	0.00	-	0.00	0.00
1130	0.59	0.39	0.00	0.42	0.00	0.00	0.00	-	0.00	0.00
1200	0.62	0.38	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00
1230	0.54	0.37	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00
1300	0.52	0.37	0.00	0.43	0.00	0.00	0.00	-	0.00	0.00
1330	0.47	0.36	0.00	0.45	0.00	0.00	0.00	-	0.00	0.00
1400	0.46	0.39	0.00	0.46	0.00	0.00	0.00	-	0.00	0.00
1430	0.54	0.35	0.00	0.47	0.00	0.00	0.00	-	0.00	0.00
1500	0.71	0.35	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.34
1530	0.79	0.38	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.30
1600	0.68	0.37	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.27
1630	0.60	0.39	0.00	0.41	0.00	0.00	0.00	-	0.00	0.00
1700	0.57	0.35	0.00	0.41	0.00	0.00	0.00	-	0.29	0.00
1730	0.58	0.35	0.00	0.42	0.00	0.00	0.00	-	0.31	0.00
1800	0.57	0.36	0.00	0.42	0.00	0.00	0.00	-	0.00	0.00
1830	0.54	0.33	0.00	0.38	0.00	0.00	0.00	-	0.31	0.37
1900	0.49	0.35	0.00	0.44	0.00	0.00	0.00	0.00	0.35	0.37
1930	0.49	0.34	-	0.41	0.00	0.00	0.00	0.00	0.40	0.47
2000	0.48	0.33	0.38	0.40	0.00	0.00	0.00	0.00	0.42	0.44
2030	0.44	0.32	0.35	0.35	0.00	0.00	0.00	0.00	0.40	0.42
2100	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.33	0.43
2130	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.32
2200	0.31	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
2230	0.30	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.42
2300	0.34	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.36
2330	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37
2400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

continued...

Table 38. Continued.

Time	Day 11	12	13	13	15	16	17	18	19	20
0000 MDST										
0030	0.00	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00
0100	0.00	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00
0130	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1230	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0400	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0500	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0530	0.00	0.00	-	0.00	0.00	0.37	0.00	0.00	0.00	0.00
0600	0.00	0.00	-	0.00	0.00	0.38	0.00	0.00	0.00	0.00
0630	0.00	0.00	-	0.00	0.00	0.32	0.00	0.00	0.00	0.00
0700	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0800	0.00	0.00	-	0.00	0.00	0.00	0.00	0.39	0.00	0.00
0830	0.00	0.00	-	0.00	0.00	0.00	0.00	0.49	0.00	0.31
0900	0.00	0.00	-	0.00	0.31	0.31	0.00	0.65	0.32	0.33
0930	0.00	0.00	-	0.00	0.47	0.00	0.00	0.72	0.38	0.38
1000	0.00	0.00	-	0.00	0.60	0.30	0.00	0.69	0.44	0.41
1030	0.00	0.00	-	-	0.68	0.46	0.29	0.68	0.43	0.40
1100	0.00	0.33	-	-	0.75	0.00	0.67	0.67	0.00	0.32
1130	0.28	0.34	-	0.28	0.72	0.47	0.81	0.58	0.49	0.37
1200	0.31	0.39	-	0.29	0.76	0.38	0.68	0.42	0.53	0.38
1230	0.31	0.48	-	0.33	0.76	0.40	0.87	0.52	0.62	0.36
1300	0.00	0.49	-	0.00	0.71	0.37	-	0.52	0.86	0.31
1330	0.30	0.45	-	0.00	0.72	-	-	0.52	0.74	0.33
1400	0.33	0.40	-	0.50	0.75	0.40	-	0.54	0.60	0.32
1430	0.36	0.39	-	0.00	0.78	0.51	-	0.48		0.32
1500	0.33	-	-	0.33	0.84	0.55	0.87	0.49	2.00	0.31
1530	0.32	-	-	0.33	0.81	0.52	0.80	0.39	2.20	0.58
1600	0.31	-	-	0.32	0.84	0.42	0.86	0.50	1.64	0.37
1630	0.31	-	-	0.31	0.86	0.46	0.74	0.59	1.15	0.00
1700	0.40	-	-	0.36	0.75	0.50	0.76	0.63	0.90	0.37
1730	0.32	-	-	0.31	0.85	0.48	0.80	0.59	0.67	0.35
1800	0.34	-	-	0.00	0.83	0.41	0.83	0.66	1.18	0.39
1830	0.31	-	-	0.33	1.05	0.41	0.94	0.63	0.77	0.38
1900	0.38	-	-	0.31	1.05	0.31	0.95	0.64	1.16	0.31
1930	0.40	-	-	0.00	1.29	0.33	1.04	0.73	1.06	0.43
2000	0.44	-	-	0.30	1.01	0.32	0.99	0.83	1.00	0.43
2030	0.45	-	-	0.34	1.11	0.30	0.99	0.91	0.57	0.31
2100	0.36	-	-	0.00	1.04	0.00	0.89	0.94	0.70	0.35
2130	0.00	-	-	0.00	1.00	0.00	0.43	0.66	0.44	0.00
2200	0.00	-	-	0.00	1.00	0.00	0.43	0.66	0.44	0.00
2230	0.00	-	-	0.00	0.59	0.00	0.55	0.38	0.32	0.00
2300	0.00	-	-	0.00	0.47	0.00	0.57	0.37	0.00	0.00
2330	0.00	-	-	0.00	0.48	0.00	0.52	0.33	0.00	0.00
2400	0.00	-	-	0.00	0.50	0.00	0.29	0.00	0.00	0.00

continued...

Table 38. Concluded.

Time	Day	21	22	23	24	25	26	27	28	29	30
0000	MDST										
0030		0.00	0.00	0.00	0.52	0.00	0.00	0.36	0.00	0.37	0.00
0100		0.00	0.00	0.00	0.35	0.00	0.00	0.36	0.00	0.34	0.00
0130		0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.28	0.00
0200		0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00
0230		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300		0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00
0330		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0400		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430		0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00
0500		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0530		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0600		0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	-
0630		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0700		0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	-
0730		0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	-
0800		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0830		0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00
0900		0.00	0.00	0.00	0.61	0.37	0.00	0.00	0.00	0.00	0.00
0930		0.00	0.00	0.00	0.55	0.34	0.00	0.00	0.00	0.00	0.00
1030		0.29	0.00	0.00	0.83	0.32	0.00	0.00	0.00	0.00	0.00
1030		0.30	0.00	0.00	0.56	0.32	0.00	0.00	0.00	0.00	0.00
1190		0.00	0.37	0.00	0.38	0.33	0.00	0.00	0.00	0.00	0.00
1130		0.31	0.36	0.00	0.34	0.34	0.30	0.00	0.00	0.00	0.00
1200		0.45	0.45	0.32	0.31	0.32	0.00	0.00	0.00	0.00	0.00
1230		0.00	0.00	0.54	0.28	0.00	0.35	0.00	0.00	0.00	0.00
1300		0.00	0.32	0.66	0.32	0.30	0.36	0.29	0.00	0.00	0.00
1330		0.00	0.39	0.65	0.38	0.00	0.44	0.33	0.00	0.00	0.00
1400		0.00	0.51	0.68	0.40	0.31	0.47	0.32	0.00	0.00	0.00
1430		0.00	0.42	0.68	0.35	0.39	0.63	0.33	0.00	0.00	0.00
1500		0.00	0.47	0.72	0.73	0.39	0.53	0.34	0.00	-	0.00
1530		0.00	0.55	0.73	1.40	0.38	0.40	0.00	0.00	-	0.00
1600		0.00	0.54	0.74	0.94	0.62	0.57	0.00	0.33	0.00	0.00
1630		0.44	0.51	0.67	0.79	0.68	0.38	0.00	0.36	0.00	0.00
1700		0.42	0.37	0.84	0.71	0.76	0.46	0.00	0.37	0.30	0.00
1730		0.43	0.31	0.39	0.64	0.88	0.51	0.00	0.31	0.29	0.00
1800		0.43	0.00	1.04	0.63	0.78	0.53	0.00	0.35	0.30	0.00
1830		0.45	0.00	0.90	0.61	0.81	0.55	0.00	0.36	0.00	0.00
1900		0.46	0.00	0.44	0.62	0.86	0.54	0.00	0.38	0.00	0.00
1930		0.45	0.00	0.81	0.55	0.84	0.52	0.00	0.43	0.00	0.00
2000		0.37	0.00	1.32	0.51	0.86	0.48	0.50	0.47	0.00	0.00
2030		0.32	0.00	1.61	0.57	0.83	0.00	0.46	0.43	0.00	0.00
2100		0.40	0.00	2.00	0.44	0.80	0.00	0.45	0.43	0.00	0.00
2130		0.00	0.00	1.98	0.39	0.55	0.00	0.41	0.37	0.00	0.00
2200		0.00	0.00	2.14	0.41	0.00	0.00	0.40	0.39	0.00	0.00
2230		0.00	0.00	2.28	0.38	0.00	0.42	0.39	0.37	0.00	0.00
2300		0.00	0.00	1.97	0.37	0.00	0.42	0.34	0.41	0.00	0.00
2330		0.00	0.00	1.19	0.00	0.00	0.41	0.30	0.40	0.00	0.00
2400		0.00	0.00	0.52	0.00	0.00	0.38	0.00	0.39	0.00	0.00

Table 39. PAN concentrations in the Kananaskis Valley, 1982 July.

Time	Day 1	2	3	4	5	6	7	8	9	10
0000 MDST										
0030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0530	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0600	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0800	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0830	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0900	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0930	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00
1100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00
1130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.34
1200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32
1230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
1300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.38
1330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.32
1400	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	-	0.00
1430	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.36
1500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00
1530	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00
1600	0.34	0.00	0.00	0.00	0.00	0.00	0.30	0.40	0.00	0.00
1630	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00
1700	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00
1730	0.35	0.00	0.00	0.00	0.00	0.00	0.00	1.04	0.32	0.00
1800	0.34	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.00	0.00
1830	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00
1900	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00
1930	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00
2030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00
2100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00
2130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00
2200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00
2230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

continued...

Table 39. Continued.

Time Day	11	12	13	14	15	16	17	18	19	20
0000 MDST										
0030	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0530	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0600	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0800	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0830	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0900	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0930	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1030	0.00	0.44	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1100	0.00	0.58	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1130	0.00	0.66	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1200	0.00	0.79	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1230	0.35	0.80	0.64	0.00	0.00	0.00	0.00	0.00	0.40	0.00
1300	0.36	1.02	0.71	0.00	0.00	0.00	0.00	0.00	0.40	0.00
1330	0.33	1.21	0.68	0.00	0.00	0.00	0.00	0.00	0.42	0.00
1400	0.00	1.03	0.69	0.00	0.00	0.00	0.00	0.00	0.44	0.00
1430	0.00	0.66	0.69	0.00	0.00	0.00	0.00	0.00	0.41	0.00
1500	0.00	0.56	0.60	0.00	0.00	0.28	0.00	0.00	0.45	0.00
1530	0.00	0.46	0.62	0.00	0.00	0.00	0.00	0.00	0.47	0.00
1600	0.00	0.52	0.62	0.00	0.00	0.00	0.00	0.00	0.51	0.00
1630	0.00	0.52	0.64	0.00	0.00	0.00	0.00	0000	0.53	0.00
1700	0.00	0.52	0.64	0.00	0.00	0.00	0.00	0.00	0.53	0.00
1730	0.00	0.46	0.61	0.00	0.00	0.00	0.00	0.00	0.49	0.00
1800	0.33	0.35	0.55	0.00	0.00	0.31	0.00	0.00	0.45	0.00
1830	0.36	0.39	0.51	0.00	0.00	0.32	0.00	0.00	0.43	0.31
1900	0.35	0.42	0.48	0.00	0.00	0.31	0.00	0.00	0.38	0.30
1930	0.00	0.33	0.40	0.00	0.00	0.00	0.00	0.00	0.38	0.31
2000	0.33	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.40	0.33
2030	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.41	0.36
2100	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.39	0.36
2130	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.36	0.34
2200	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.36	0.00
2230	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.36	0.30
2300	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.34	0.00
2330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00
2400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00

continued...

Table 39. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0000 MDST											
0030	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0530	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0600	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0800	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0830	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00
0900	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.31	0.00	0.00
0930	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.35	0.00	0.00
1000	0.00	0.00	0.00	0.00	0.32	0.00	0.33	0.45	0.41	0.00	0.00
1030	0.00	0.00	0.00	0.39	0.33	0.00	0.36	0.47	0.45	0.00	0.00
1100	0.00	0.00	0.00	0.00	0.38	0.00	0.34	0.53	0.44	0.00	0.00
1130	0.00	0.00	0.00	0.32	0.43	0.29	0.00	0.54	0.00	0.00	0.00
1200	0.00	0.00	0.00	0.31	0.44	0.37	0.00	0.37	0.00	0.00	0.00
1230	0.00	0.00	0.00	0.32	0.52	0.41	0.30	0.31	0.00	0.00	0.00
1300	0.00	0.00	0.00	0.39	0.79	0.42	0.36	0.00	0.00	0.00	0.00
1330	0.00	0.00	0.00	0.42	0.84	0.43	0.40	0.00	0.00	0.00	0.00
1400	0.00	0.00	0.00	0.47	0.73	0.45	0.34	0.29	0.00	0.00	0.00
1430	0.00	0.00	0.00	0.39	0.48	0.43	0.50	0.60	0.00	0.00	0.00
1500	0.32	0.00	0.00	0.37	0.60	0.46	0.46	0.60	0.00	0.00	0.00
1530	0.38	0.00	0.00	0.45	0.54	0.43	0.55	0.54	0.00	0.00	0.00
1600	0.42	0.00	0.00	0.51	0.61	0.44	0.33	0.42	0.00	0.00	0.00
1630	0.45	0.00	0.00	0.56	0.53	0.46	0.00	0.36	0.00	0.00	0.00
1700	0.52	0.00	0.00	0.56	0.42	0.51	0.00	0.34	0.00	0.00	0.00
1730	0.58	0.00	0.00	0.54	0.44	0.48	0.36	0.00	0.00	0.00	0.00
1800	0.61	0.00	0.00	0.54	0.52	0.46	0.38	0.36	0.00	0.00	0.00
1830	0.88	0.00	0.00	0.51	0.48	0.44	0.29	0.45	0.00	0.00	0.00
1900	0.33	0.00	0.00	0.49	0.43	0.42	0.00	0.58	0.00	0.00	0.00
1930	0.00	0.00	0.00	0.44	0.50	0.40	0.00	0.99	0.99	0.99	0.00
2000	0.00	0.00	0.00	0.41	0.36	0.46	0.00	1.06	0.00	0.00	0.00
2030	0.00	0.00	0.00	0.39	0.00	0.00	0.33	0.86	0.00	0.00	0.00
2100	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.80	0.00	0.00	0.00
2130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00
2200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00
2230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.34	0.00	0.00
2300	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.39	0.00	0.00	0.00
2330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 40. PAN concentrations in the Kananaskis Valley, 1982 August.

Time	Day 1	2	3	4	5	6	7	8	9	10
0000 MDST										
0030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0500	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0530	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0600	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0630	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0700	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0800	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0830	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0900	0.00	0.00	0.00	0.00	0.00	-	0.30	0.00	0.00	0.00
0930	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00
1000	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00
1030	0.00	0.00	0.00	0.00	0.00	-	0.40	0.33	0.00	0.00
1100	0.00	0.00	0.00	0.00	-	-	0.45	0.39	0.34	0.00
1130	0.00	0.00	0.00	0.00	-	-	0.59	0.51	0.31	0.00
1200	0.00	0.00	0.00	0.28	-	0.00	0.70	0.52	0.32	0.00
1230	0.00	0.00	0.00	0.28	0.00	0.00	0.75	0.66	0.00	0.00
1300	0.00	0.00	0.00	0.00	0.00	-	0.82	0.77	0.00	0.00
1330	0.00	0.00	0.00	0.30	0.00	-	0.50	0.65	0.35	0.00
1400	0.00	0.00	0.00	0.34	0.00	-	0.37	0.38	0.45	0.30
1430	0.00	0.00	0.00	0.31	0.00	0.00	0.31	0.32	0.48	0.00
1500	0.00	0.00	0.00	0.30	0.00	0.00	0.32	-	0.58	0.00
1530	0.00	0.00	0.00	0.32	0.00	0.00	0.00	-	0.61	0.29
1600	0.00	0.00	0.00	0.30	0.00	0.00	0.00	-	0.48	0.00
1630	0.00	0.00	0.00	0.00	-	0.00	0.00	-	0.00	0.00
1700	0.00	0.00	0.00	0.29	-	0.00	0.00	-	0.00	0.00
1730	0.00	0.00	0.00	0.00	-	0.00	0.00	-	0.00	0.00
1800	0.00	0.00	0.00	0.29	-	0.00	0.00	-	0.00	0.00
1830	0.00	0.00	0.00	0.00	-	0.00	0.00	-	0.00	0.00
1900	0.00	0.00	0.00	0.00	-	0.00	0.00	-	0.00	0.00
1930	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.31	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.48	0.00	-	0.38	0.00
2030	0.00	0.00	0.00	0.00	0.00	0.43	0.00	-	0.35	0.00
2100	0.00	0.00	0.00	0.00	0.00	0.45	0.00	-	0.37	0.00
2130	0.00	0.00	0.00	0.00	0.00	0.46	0.00	-	0.38	0.00
2200	0.00	0.00	0.00	0.00	0.00	0.44	0.00	-	0.37	0.00
2230	0.00	0.00	0.00	0.00	0.00	0.32	0.29	-	0.35	0.00
2300	0.00	0.00	0.00	0.00	0.00	0.00	0.29	-	0.33	0.00
2330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.35	0.00
2400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.28	0.00

continued...

Table 40. Continued.

Time	Day	11	12	13	14	15	16	17	18	19	20
0000	MDST										
0030		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0100		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0130		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0230		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0400		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0430		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0500		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0530		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0600		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0630		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0700		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0800		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0830		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0900		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0930		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00
1000		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00
1030		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.34
1100		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.30
1130		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.30
1200		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00
1230		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.37
1300		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1330		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1400		0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1430		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1500		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1530		0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1600		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1630		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1700		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1730		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1800		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1830		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1900		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.00
1930		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00
2000		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	0.00
2030		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.53	0.00
2100		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
2130		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00
2200		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2230		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2300		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2330		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2400		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

continued...

Table 40. Concluded.

Time	Day 21	22	23	24	25	26	27	28	29	30	31
0000 MDST											
0030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0330	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0430	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0530	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0600	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0730	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0800	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
0830	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0900	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0930	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1230	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00
1300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1400	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1430	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1530	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1600	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1630	0.00	0.32	0.00	0.34	0.30	0.00	0.00	0.00	0.00	0.00	0.00
1700	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1730	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00
1800	0.00	0.29	0.00	0.34	0.30	0.00	0.00	0.00	0.29	0.00	0.00
1830	0.00	0.00	0.00	0.36	0.33	0.00	0.00	0.00	0.00	0.00	0.00
1900	0.00	0.00	0.00	0.36	0.33	0.00	0.00	0.00	0.00	0.00	0.00
1930	0.00	0.00	0.00	0.38	0.29	0.00	0.00	0.00	0.00	0.00	-
2000	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	-	0.00	-
2030	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
2100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
2130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
2200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
2230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
2300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
2330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
2400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-

9.5 METEOROLOGICAL REPORT

This report on the meteorological conditions prevailing on selected days was prepared by INTERA ENVIRONMENTAL CONSULTANTS LTD. in support of the research program.

FINAL REPORT
OF
METEOROLOGICAL STUDY IN
SUPPORT OF PAN STUDY

prepared for

KANANASKIS CENTRE FOR ENVIRONMENTAL RESEARCH

University of Calgary

Calgary, Alberta

prepared by

INTERA ENVIRONMENTAL CONSULTANTS LTD.

Calgary, Alberta

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ABSTRACT

Meteorological factors which affected transport and diffusion of contaminants such as Peroxyacetyle nitrate (PAN) in the atmosphere of the Calgary urban area on selected days in 1981 are reviewed. The valley wind circulation in the Bow River valley has a very strong influence on PAN concentrations in the City of Calgary. Mid-day peak values of PAN are enhanced on days when the valley flow dominates the wind field because the flow direction typically shifts direction at about this time from down valley to up-valley. This direction shift is typically occupied by a period of light and variable winds so that higher concentration levels might be expected to occur. Also, air which is over the city centre in the early morning is also often advected back over the city in the early afternoon. Derived trajectories suggest that the valley flow can cause night-time peaks in PAN concentration to occur when air which is advected up the valley from the city during the afternoon and early evening is advected back over the city during the night. Crude diffusion estimates suggest that night-time peak values would be 15-25% of the preceding daytime concentrations.

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1. INTRODUCTION

Peroxyacetyl nitrate (PAN) and ozone are two important secondary photochemical air pollutants found in an urban atmosphere. PAN is believed to form in the atmosphere as the result of a complicated chemical process which is influenced by solar radiation, the magnitude of primary pollutant emission and by meteorological parameters such as temperature, mixing volumes and ventilation rates.

A program to measure PAN and other photochemical pollution in the Calgary area was undertaken by the Kananaskis Research Centre at the request of the Alberta Department of the Environment. Peake and Sandhu (1982) discussed results of the initial analyses of the measurements. They observed several events in the PAN data which were not completely explained by accepted models of PAN formation. For example, several nighttime peaks in PAN concentration were observed. Also, one of the highest peak concentrations was detected in January 1981 when the maximum air temperature was only about 0°C and solar radiation levels were relatively low.

Peake and Sandhu tentatively suggested that these events could be explained by reference to the meteorology of Calgary and the Bow River Valley. A study of the meteorology was undertaken by INTERA in response to their suggestion.

This study had two objectives:

1. Prepare a description of the meteorology affecting transport and diffusion in the Calgary area for selected case studies; and
2. Construct air-mass trajectories and determine if the nighttime peaks in PAN concentration could be explained by air mass movement.

The results of the study are presented in the following sections.

2. DESCRIPTION OF STUDY METHODOLOGY

2.1 TRAJECTORY COMPUTATION

A relatively simple procedure has been used to compute trajectories for this study. This consisted of selecting one or more of the available stations and computing a trajectory from the hourly observed wind speeds and directions. (If more than one station was selected, mean values were used). This procedure therefore used an eulerian data set to compute a lagrangian quantity (the trajectory). Spatial variations in the wind field were ignored and the hourly mean wind was assumed constant over each hour.

As discussed in later sections there are differences in the measured wind at the different stations within the city; however, the significant features of the wind field were relatively consistent between stations and the level of accuracy in the data sets did not, at this time, justify more sophisticated approaches.

An example trajectory is shown in Figure 2.1. One advantage of the approach adopted here is that the origin can be moved in time along the trajectory and the subsequent trajectory of the air mass from this origin can be determined. For example, the trajectory of the air mass which is at point A at time 0300 in Figure 2.1 is at point B at time 1200, and subsequently back at point A at time 1800.

2.2 DISPERSION ESTIMATION

Because of the limitations of the available data, only approximate estimates of atmospheric dispersion can be given in this report. A good general review of atmospheric diffusion processes is found in Pasquill (1974); the following discussion draws from that review.

Dispersion rates depend on ambient turbulence which in turn depends on surface roughness, the sensible heat flux, the wind speed and the boundary layer height. Terrain-induced flow features complicate the problem. Further uncertainties are introduced in urban areas, because of the increased roughness (compared to rural areas) due to city structures, and, because of the extra heating which leads to the urban heat island effect.

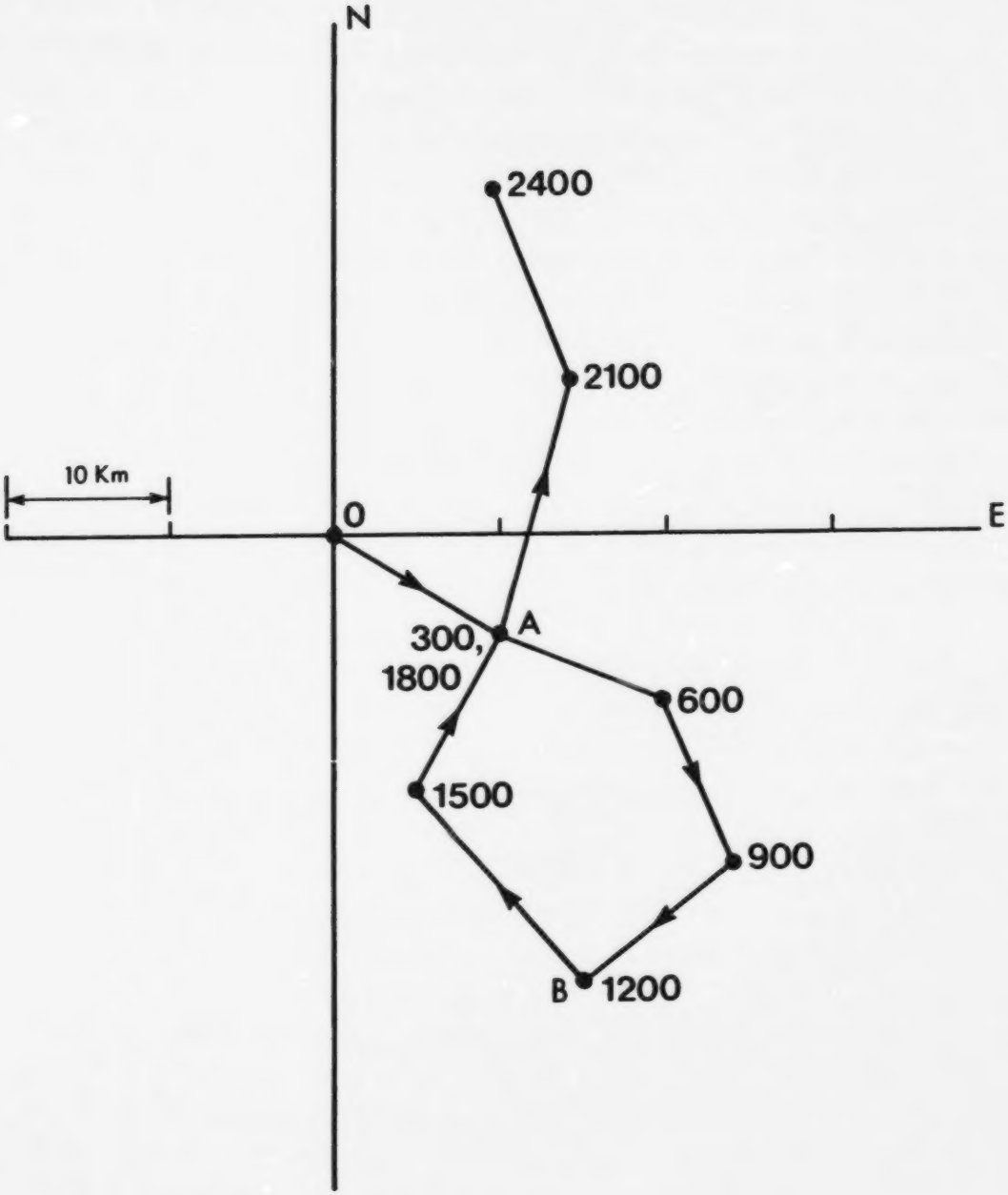

Figure 2.1. Example of a trajectory plot. See text for discussion.

Estimating dispersion requires specifying crosswind and vertical spread as a function of distance from the source. The crosswind and vertical dimension of the pollutant "plume" can be expressed in several ways. For example the dimensions can be expressed as the standard deviation of the distribution of the pollutant; i.e., for the crosswind dimension

$$\sigma_y^2 = \frac{\int M(y)^2 dy}{\int M(y) dy} \qquad (1)$$

where M(y) is the concentration at a distance y from the centerline. A similar formula holds for the standard deviation in the vertical. Another commonly used definition is the width between which concentrations fall to some specified fraction of the centerline or peak concentration.

In order to estimate dispersion from the city area source the approximation will be made that the city source is initially a uniformly mixed box of width D and height H. As represented schematically in Figure 2.2 the plume will spread continuously in the crosswind direction but will be limited in vertical extent by the inversion layer (during the daytime). The development of expressions for crosswind and vertical spread as functions of downwind distance are given below.

2.2.1 Crosswind Spread

As discussed above crosswind spread can be expressed in terms of the standard deviation, σ_y. Davison and Leavitt (1979) reviewed Alberta Oil Sands sigma measurements and suggested that for a point sources beyond distances where source affects are important, crosswind plume spread, is well approximated by the following equation:

$$\sigma_y = \sigma_\theta \, (2 \, I_v X)^{1/2} \qquad (2)$$

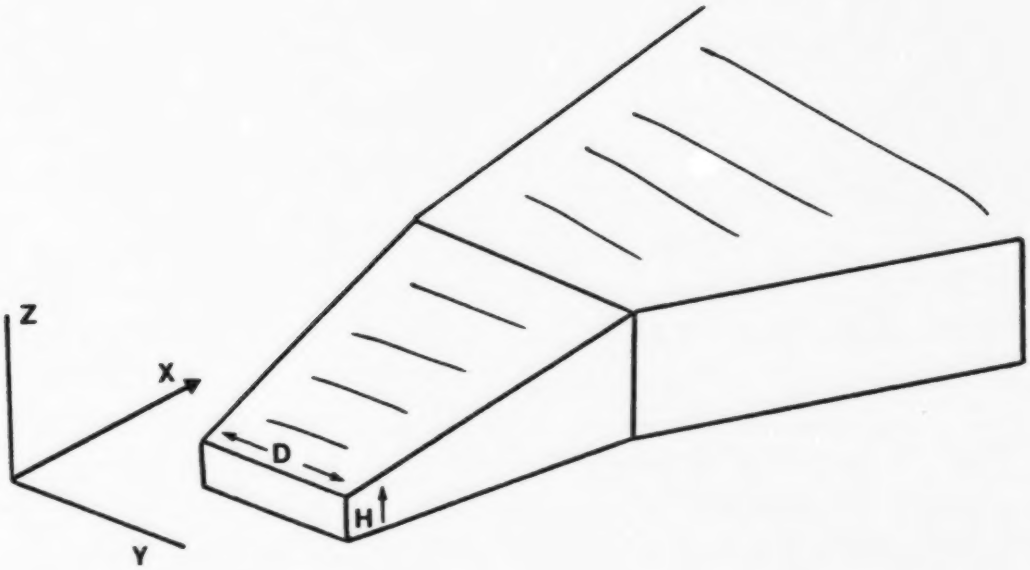

Figure 2.2. Schematic showing how the city plume will spread in both crosswind and vertical directions until H equals the inversion height. The approximation is made that the plume is uniformly distributed in the vertical.

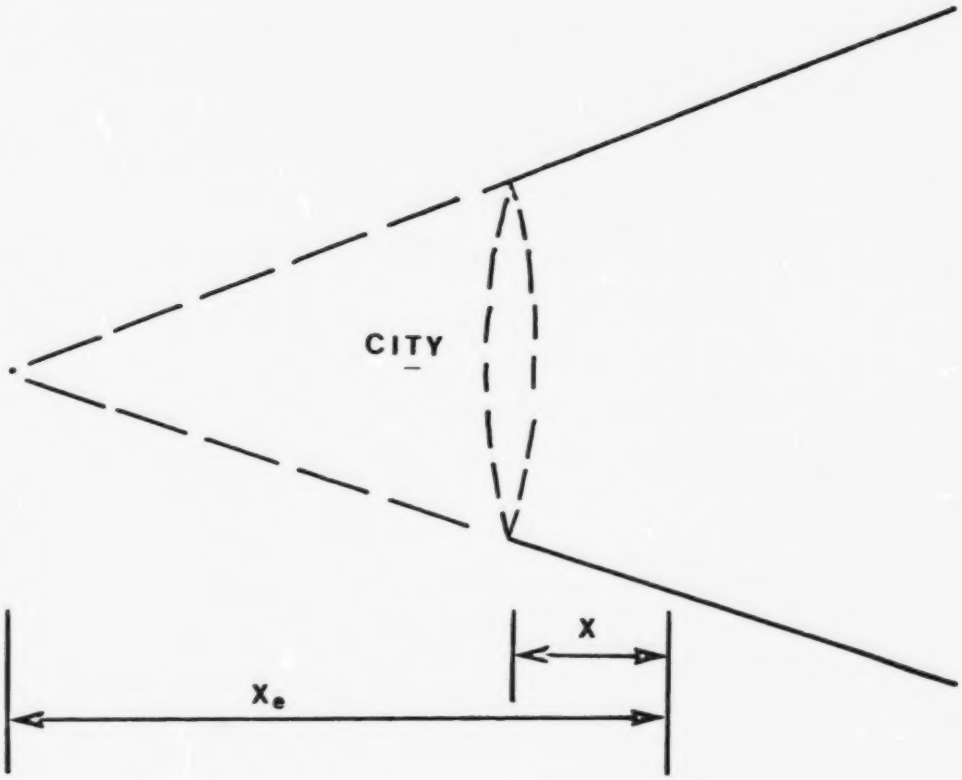

Figure 2.3 Illustration of the difference between the actual downwind distance (X) and the effective downwind distance X_e.

where $\sigma\theta$ is the standard deviation of the fluctuations in the lateral wind direction, l_v is a lagrangian length scale and x is downwind distance. Equation 2 was first derived by Taylor (1953) using statistical arguments.

This formula can be adapted for a finite width area source by introducing the concept of an effective downwind distance as used by Davison et al. (1981) for the Alberta Environment gaussian plume dispersion model and illstrated in Figure 2.3. If σ_{yo} is the initial standard deviation of the area source (at x = 0); then the effective downwind distance (X_e) at x = 0 is found by matching sigmas such that

$$X_e = \frac{(\sigma_y)^2/2\ l_v}{\sigma\theta} \qquad (3)$$

From Davison et al. (1981), $l_v \approx 500$ m. In unstable or convective conditions, $\sigma\theta$ will range between 10 and 30°, and in stable conditions, (nocturnal), $\sigma\theta$ will be typically less than 5°, e.g., Davison et al. (1981).

The initial width of the Calgary plume is uncertain, but it is probably in the order of about 5 km with a σ_{yo} value of about 1.2 km. This estimate of σy_o is obtained by assuming the source has a box or top-hat profile (as in Figure 2.2) so that $\sigma_{yo} = D/4.3$ where D is the source width.

Substituting in equation (2) for convective conditions

$$X_e \quad 12.0 \text{ at } X = 0 \text{ and} \qquad (4)$$
$$\sigma_y \quad 11.0\ (X + 12000)^{1/2}$$

The doubling distance for σy (a decrease of concentration of 50%) is then x = 35-40 km.

Table 2.1 gives the variation of σ_y with downwind distance computed using equation (3). During stable conditions (i.e., nocturnal inversions), the downwind decrease in concentration would be much less (Table 2.1) than in convective conditions. It is reasonable, therefore, to assume that lateral dispersion can be ignored during evening and early-morning hours.

Table 2.1. Approximate values for σ_y as a function of downwind distance in convective conditions (σ_θ = 20°, X_e = 12 km) and stable conditions (σ_θ = 5° and X_e = 756 km) where initial σ_y is 1200 m.

	X(km)						
	1	5	10	20	30	40	50
Conv.	1250	1430	1630	1970	2250	2510	2740
Stable	1203	1216	1230	1260	1290	1320	1350

	X(km)		
	60	75	100
Conv.	2950	3240	3680
Stable	1380	1420	1485

2.2.1 Vertical Spread

An equation for vertical spread can be developed using a formulation similar to that used above for crosswind spread; however, vertical spread will be limited in convective conditions by the inversion at the top of the boundary layer (see Figure 2.2). In convective conditions, it can be expected that pollutants will be relatively evenly dispersed throughout the depth of the boundary layer at some distance downwind from the source.

Pasquill presents results from studies in St. Louis that suggest that at downwind distances of 5 to 10 km, the average depth of vertical dispersion will be about 500 m. From available data, this is approximately equal to the depth of the boundary layer occurring on August afternoons over the city of Calgary. The data quoted by Pasquill also suggest that, for downwind distances of about 1 km, the average depth is about 200 m. Therefore, it will be assumed that the depth of vertical dispersion in the downtown area in convective conditions is about 200 m, and that this mixing depth will double every 5 km until it matches the boundary layer depth.

Vertical mixing is more limited in stable conditions (Davison and Leavitt, 1979) such that it is reasonable to assume that no additional vertical mixing occurs once solar heating ceases in the evening.

2.3 CASE STUDIES

The dates of the four selected case studies are:

1. 27 January;
2. 5-6 August;
3. 10-14 August; and
4. 28-29 August.

All dates were in 1981 and unless stated otherwise, Mountain Standard Time (MST) is used throughout this report.

2.4 DATA

The following types of data were available for this study:

1. Surface pressure and 850 mb maps provided by Western Region of the Atmospheric Environment Service (AES);
2. Hourly observations of wind, temperature and other weather for the Calgary International Airport provided by the Physics Department of the University of Calgary. (These were copies of monthly summaries prepared by the AES);
3. Hourly observations of wind speed and direction from gas plants near the city. These included gas plants at Wildcat Hills (Nova), Jumping Pound (Petro Canada), Okotoks (Texasgulf), Crossfield (Amoco) and Balzac (Petrogas). These data were provided by Alberta Environment;
4. Rawinsonde-derived wind and temperature profiles for the Calgary area as often as twice a day. These data were made available by the Alberta Hail Project office in Penhold, Alberta;
5. Hourly observations of wind and temperature as measured at the University of Calgary, Springbank Airport and Mount Royal College weather stations; and
6. Acoustic sounder records of inversion heights from Mount Royal College, and the Springbank and Calgary International airports. These data and data described in (5) were provided by the University of Calgary.

Table 2.2 describes those data available for each day of the selected case studies. In this table, and in the following sections, the references to the city weather stations will be abbreviated as follows:

1. UC - University of Calgary;
2. MRC - Mount Royal College;
3. SB or Springbank - Springbank Airport; and
4. Airport - Calgary International Airport.

The locations of the various stations are indicated on the map given in Figure 2.4.

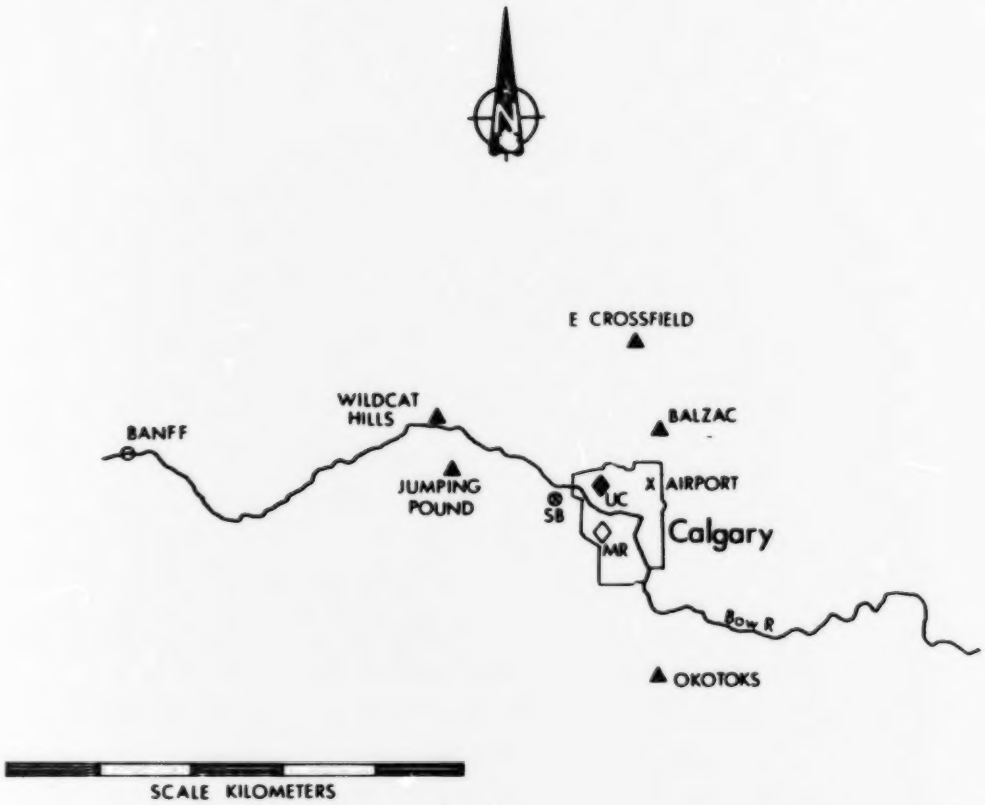

Figure 2.4. Locations of the various weather stations used in this study.

Table 2.2. Catalog of meteorological data available for this study. * indicates data available on that date. H is boundary layer height from acoustic sounder.

DATE	STATIONS											
	UC		MRC			AIRPORT				SB		
	Wind	Temp.	Wind	Temp.	H	Wind	Temp.	H	Misc. Climat	Wind	Temp.	Sounder
27 Jan.	*	*		*	*	*	*		*	*	*	
5 Aug.	*	*				*	*		*	*	*	
6 Aug.	*	*				*	*		*	*	*	
10 Aug.						*	*		*			
11 Aug.	*	*				*	*	*	*	*	*	
12 Aug.	*	*				*	*	*	*	*	*	
13 Aug.	*	*				*	*		*	*	*	
14 Aug.	*	*				*	*	*	*	*	*	
28 Aug.		*				*	*		*	*	*	*
29 Aug.		*				*	*		*	*	*	*

2.4.1 Data Limitations

The surface pressure maps are available every six hours (0, 6, 12, and 18 GMT) and the 850 mb maps are available every 12 hours (0 and 12 GMT) for all study periods.

The hourly records from the UC, MRC, Springbank and Airport stations report wind direction using a 16-point compass. Gas plant winds are reported, however, using only an eight-point compass. Although the resolution in these latter winds was judged unsuitable for trajectory computations, these data were useful in verifying flow features such as the possible extent of a valley wind along the Bow River Valley.

From Table 2.2, it is apparent that acoustic sounder data were available only at limited times. During August, the quality of the available data was limited in the afternoons so that mixing height estimates are very uncertain for the afternoons of the August case studies. In particular, no acoustic sounder data were available for 5-6 August.

3. CASE STUDY SUMMARIES: TRAJECTORIES AND METEOROLOGY

3.1 INTRODUCTION

In this section, each case study is discussed under the following two headings:

1. Trajectories; and
2. General meteorological conditions.

Dispersion characteristics are discussed in Section 4.

3.2 27 JANUARY 1981 CASE STUDY

3.2.1 Trajectory

The air mass trajectory for 27 January, computed using the city wind station data as described in Section 2.1, is shown in Figure 3.1. From the figure, it can be seen that there are some differences among the winds measured at the Airport and at the UC and Springbank stations. In particular the wind field at the latter two stations tends to be more often northwesterly relative to the Airport.

As discussed further in a following section, the differences in winds measured at the various stations are a result of the influence of the terrain in the flow. Both the UC and Springbank stations are located in areas that are affected by valley flows more often than the Airport stations.

The major feature shown in the trajectories plotted in Figure 3.1 is the reversal in translation direction between 1200 and 1400. Concentrations of pollutants would tend to increase because of the resultant stagnation. Also, air which was over the city in the morning hours would be advected back over the city in the early afternoon.

3.2.2 Meteorology

The primary synoptic scale features which influenced the flow are a high-pressure centre in Saskatchewan, which tracked southward during this time period, and a stationary cold front which lay along the mountains to the west of Calgary. This front had moved through Calgary late on 26 January.

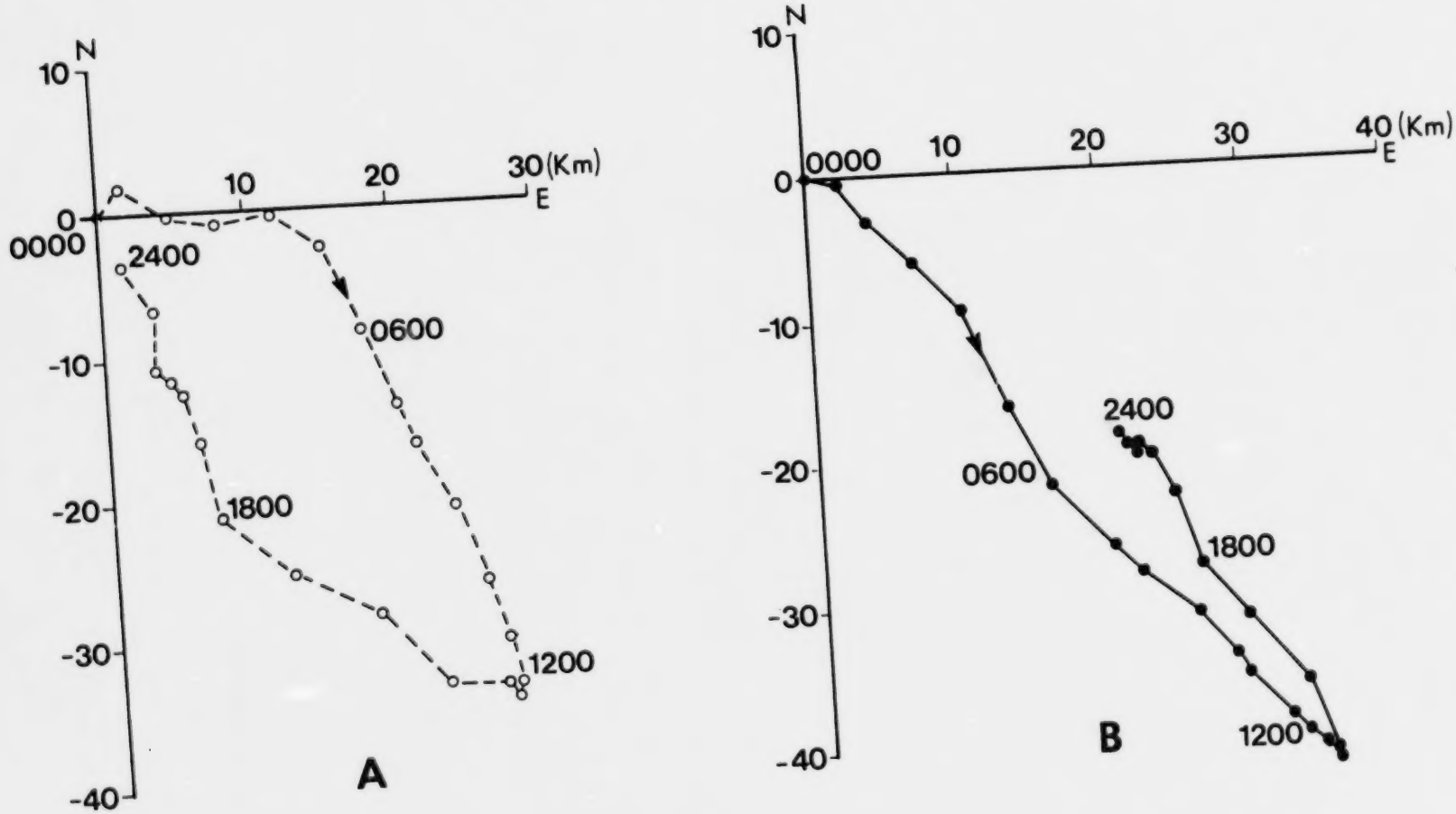

Figure 3.1. Computed trajectories for 27 January 1981. A is the average of UC, SB and Airport station winds and B is the average of UC and SB station winds.

The reversal in wind direction at mid-day was caused by a combination of two factors: (1) differential solar heating of inclined valley slopes which would cause an up-valley flow (e.g., Defant 1951); and (2) the influence of the high pressure centre as it moved further east. (Air tends to flow clockwise around a high which in this case would have resulted in a southeasterly wind). It is not possible to say which affect would have been the dominating factor.

The surface pressure maps also show that a small low developed to the southeast of Calgary in the mid-morning hours in connection with the stationary front (Figure 3.2). It appears that the UC and Springbank stations were experiencing northwesterly valley winds, but the Calgary Airport was not, until this low developed in the mid-morning hours. It is not clear whether the low caused the wind to reverse at the Airport, or, if the low compensated for the synoptic gradient sufficiently to allow the valley (drainage) wind regime to extend farther east.

Although traces of snow were recorded at the Airport, a total of seven hours of insolation was recorded at the airport on 27 January and winds were generally light (2-3 m/s). The boundary layer height as measured by the Mount Royal Acoustic Sounder was about 150 m (Figure 3.3). This height is related to the rates of mechanical mixing and the rate of radiational cooling/heating. Although it can not be confirmed, it is likely that the boundary layer was stably stratified. (On the previous day, wind speeds were approximately twice as great and the boundary layer height was about 250 m). The maximum air temperature in the city was about 0°C; outside the city, maximum temperatures were several degrees cooler.

The combination of flow stagnation and flow reversal at mid-day, plus the low boundary layer height would enable high-concentration levels to be reached on this day. Although sun angles were low, there was also an above-average (for this time of year) amount of solar radiation.

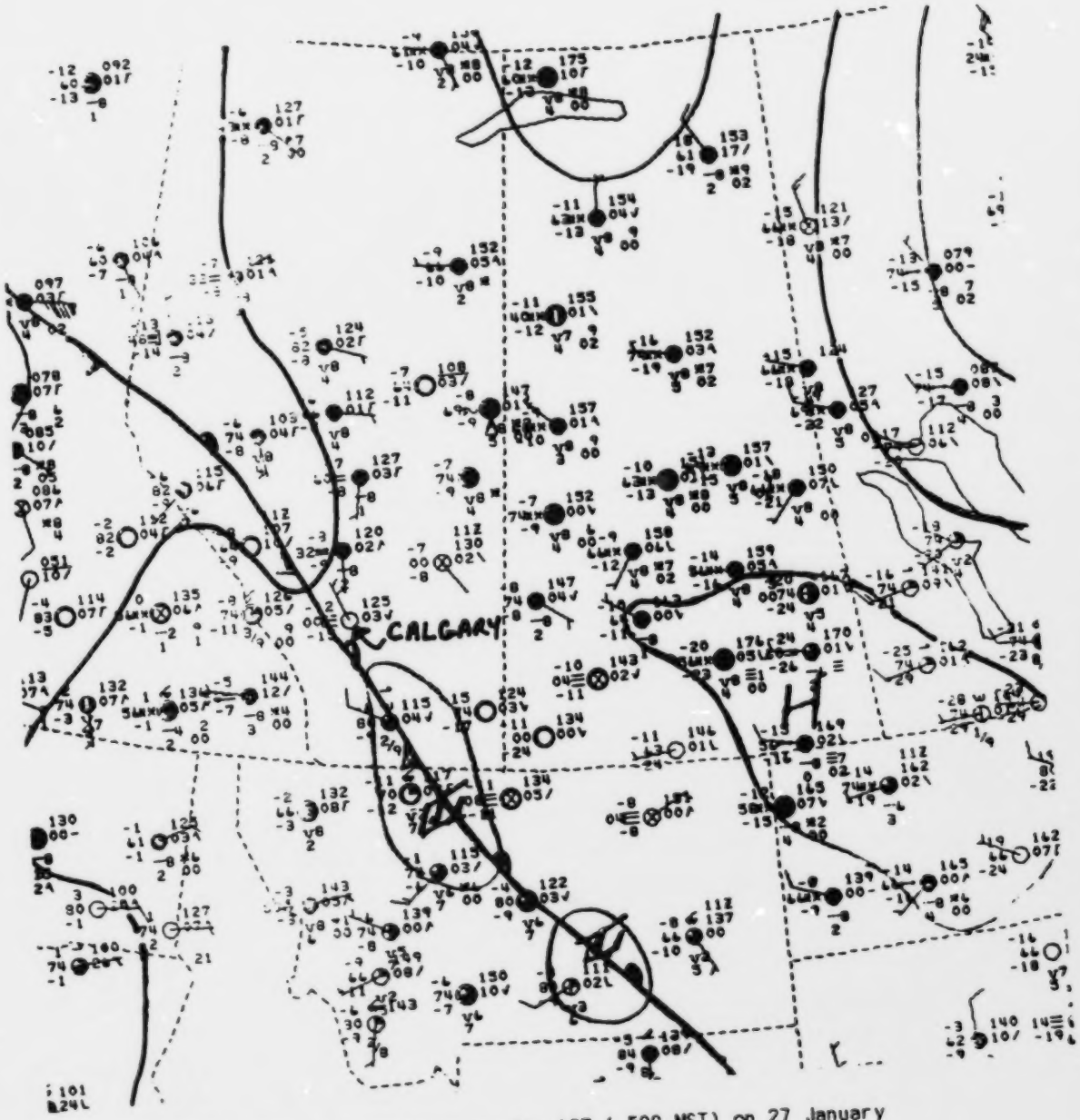

Figure 3.2. Surface pressure map for 12Z (500 MST) on 27 January 1981.

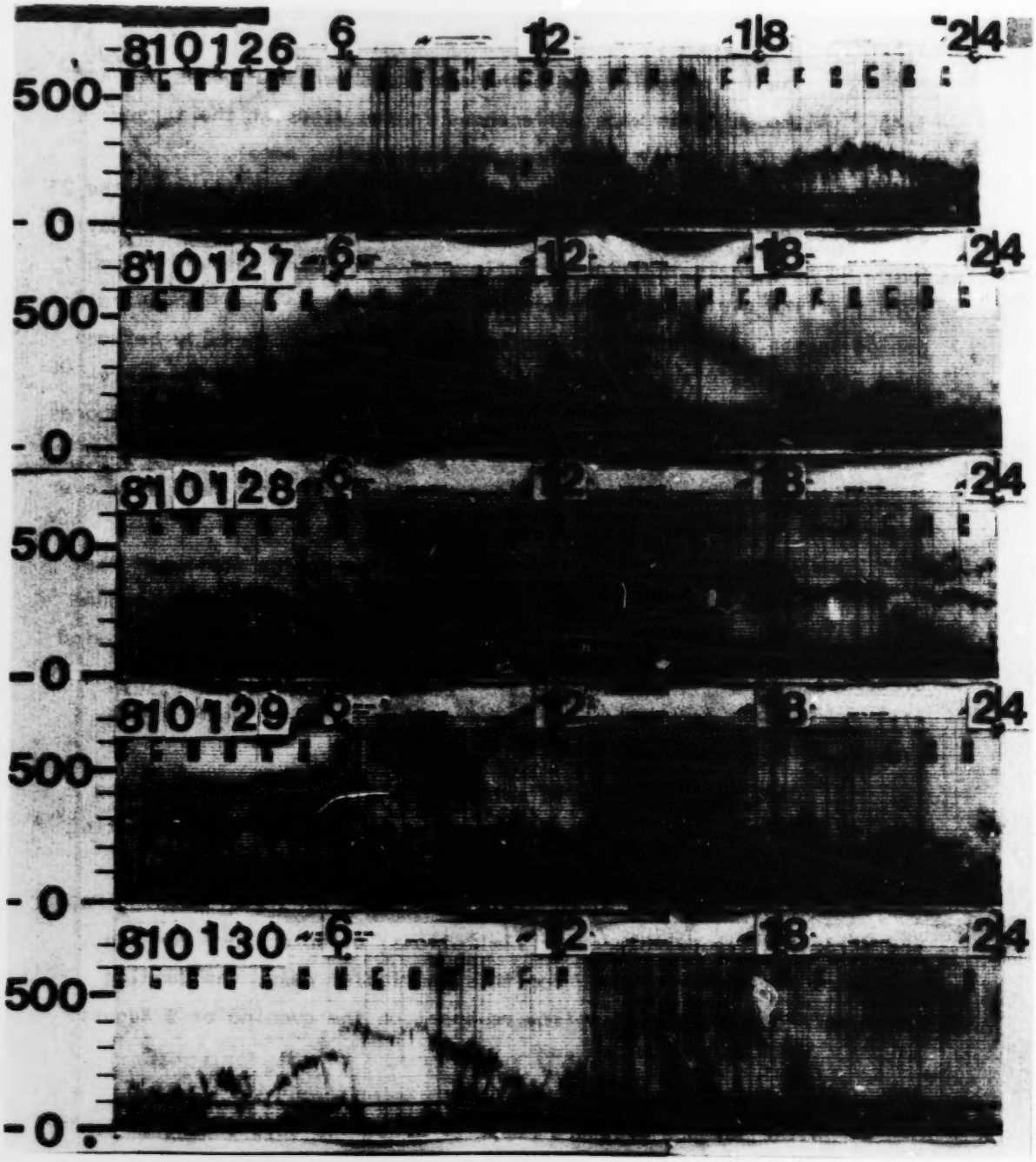

Figure 3.3. Acoustic sounder record from Mount Royal College for 26-30 January 1981.

3.3 5-6 AUGUST 1981 CASE STUDY

3.3.1 Trajectories

The trajectories for both days are shown in Figures 3.4 and 3.4a. (Although there were differences in the winds at the three stations, results were similar and are not plotted here).

Several features can be seen in this plot. Similar to the 27 January case, the wind direction reversed around mid-day on both days. A second feature is that the directions also reversed late on 5 August such that the air which was over the city during the peak concentration period in the early afternoon was advected back over the city between 0000 and 0300 on 6 August. There was thus a potential for an early-morning peak in concentration on 6 August. (The Airport hourly records indicate that a similar reversal in direction occured at midnight on 7 August; however, the trajectory did not redirect the air mass back over the city.

A third feature is the great distance to the northwest that material can be advected from Calgary. There is a tendency to assume that most advection is to the east due to the prevailing westerly wind direction. This case study (and 27 January) shows that air from the city can potentially impinge on the front range to the west of the city.

Care must be taken in extrapolating winds measured in the city to large distances upwind or downwind of the city when computing trajectories. This is only a crude approximation to the real trajectory; however, the wind data from the gas plants at Jumping Pound and Wildcat Hills (within their limitations) offer support for the existence of a valley flow. For this particular case, the Jumping Pound records also showed a flow reversal on the evening of 5 August.

3.3.2 Meteorology

The surface pressure maps for these two days showed a relatively stationary synoptic situation; a "typical" August case with high pressure centred over the study area. Only small changes occurred in the surface pressure field during this two-day period.

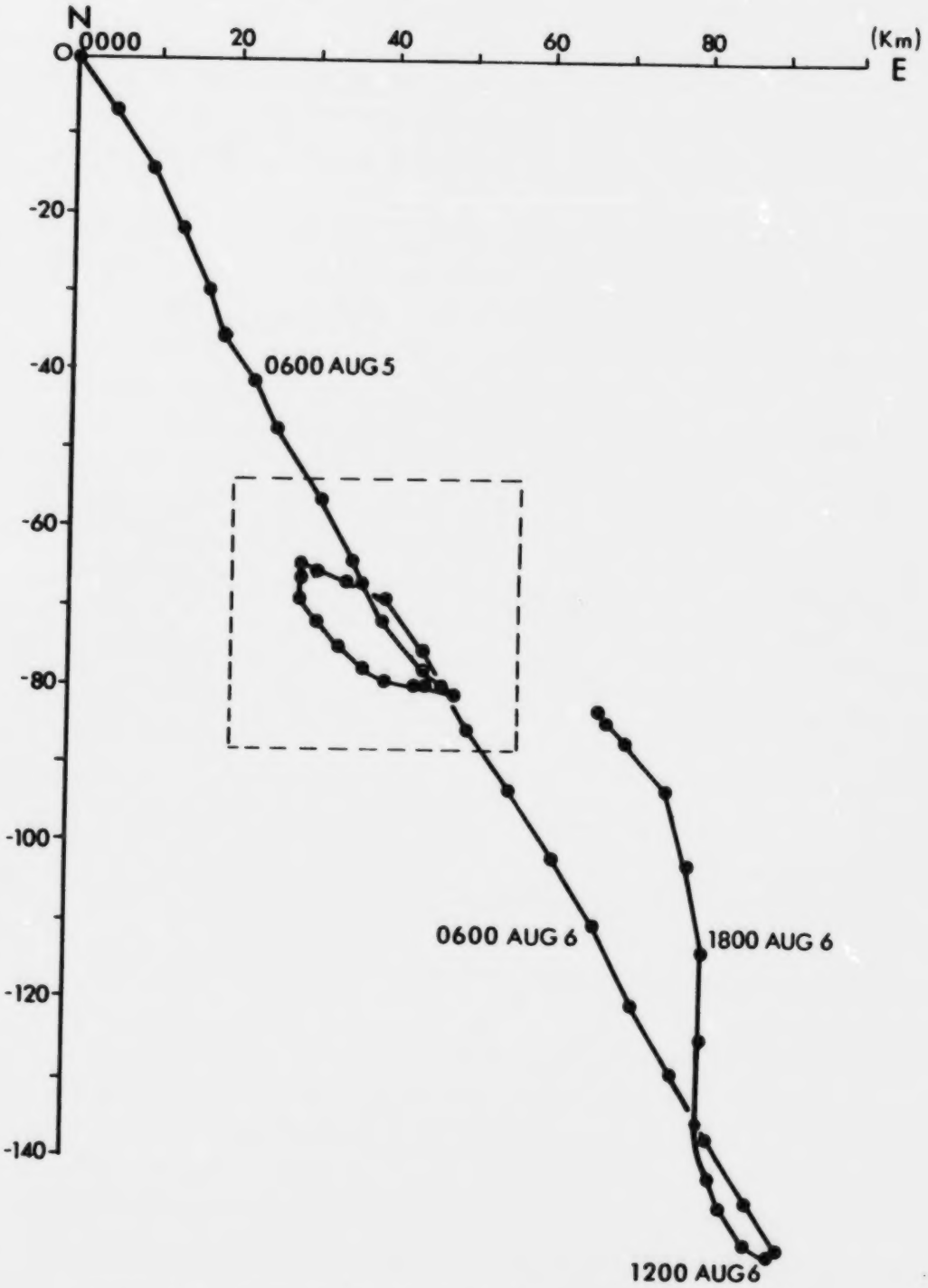

Figure 3.4. Computed trajectory for 5-6 August 1981 using winds from two stations, University of Calgary and Springbank. Details of the outlined areas are shown in Figure 3.4a.

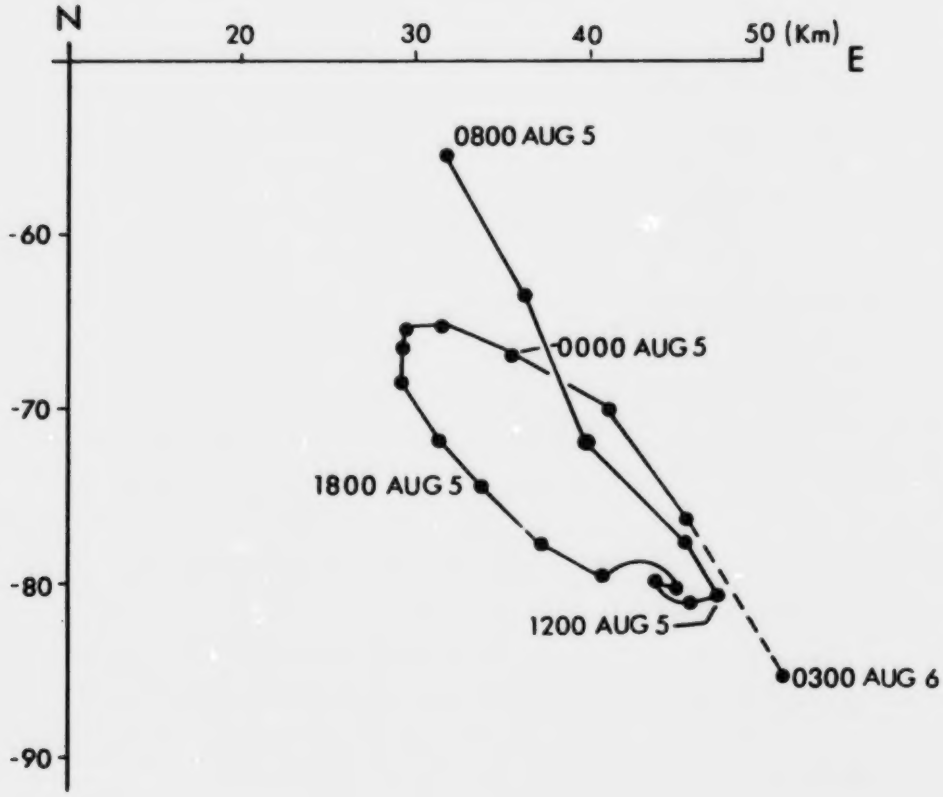

Figure 3.4a. Details of trajectory on 5 August inside the area outlined in Figure 3.4.

Winds measured during rawinsonde ascents from the Calgary Airport suggest that the valley flow was dominating the local wind field. The data also suggest existence of a recirculating flow. For example, on the afternoons, of both 5 and 6 August, the near-surface wind was oriented up the valley while the flow above the boundary layer was down valley. Likewise, on the morning of 6 August, the surface flow is oriented down-valley, with evidence of a return flow up the valley between the surface and upper level flows. (The upper level remained northwesterly throughout this case study).

The up-valley afternoon flow was stronger on 6 August than 5 August although the reason could not be determined from the available data. Maximum air temperatures were slightly higher on 6 August (26-24°), which may mean that solar heating was more effective in driving the valley circulation, or perhaps the synoptic pressure gradient was more favourable for a valley circulation.

3.4 10-14 AUGUST CASE STUDY

3.4.1 Trajectories

Trajectories are plotted for 10-11, 11-12 and 13-14 August in Figures 3.5, 3.6, and 3.7 respectively. These trajectories were computed using UC and Springbank winds, except for 10 August where Airport winds were used. The trajectory for the 14 August is also plotted in Figure 3.8 to show the details more clearly.

Wind speeds were light and directions were very variable in the morning hours of 10 August. After 1400, the flow was up-valley until about midnight, at which time it reversed direction, becoming a drainage wind.

On 11 August, flow was towards the southeast until about 1000 hours when the direction shifted nearly 180°. This shift about noon was similar to shifts observed in the two previously discussed case studies. The flow continued to be southeasterly until just after midnight, at which point it again reversed direction nearly 180°. On 12 August, the mid-day wind direction shift was only from the northwest to northeast.

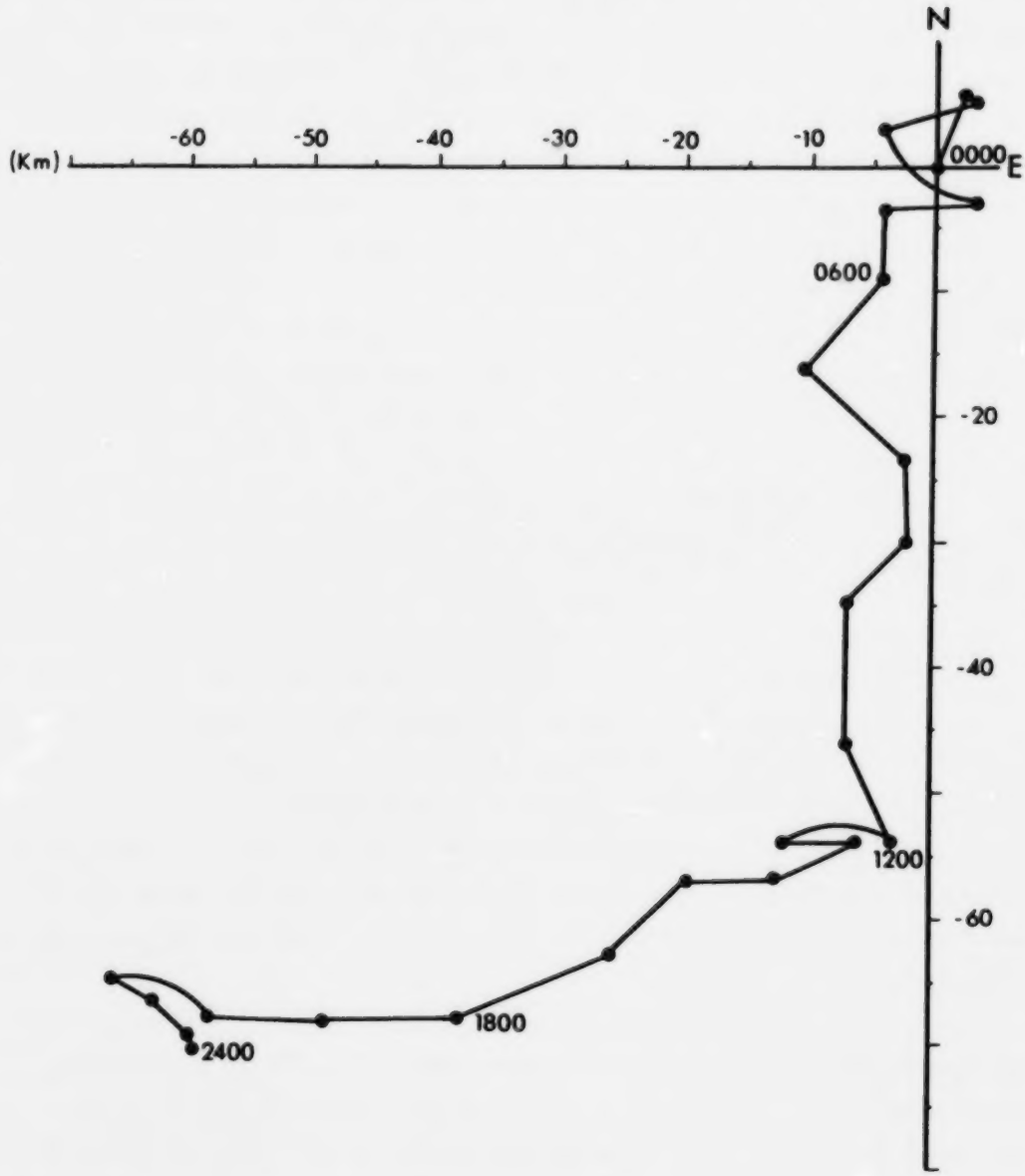

Figure 3.5. Computed trajectories for 10 August. On 10 August only airport winds are used.

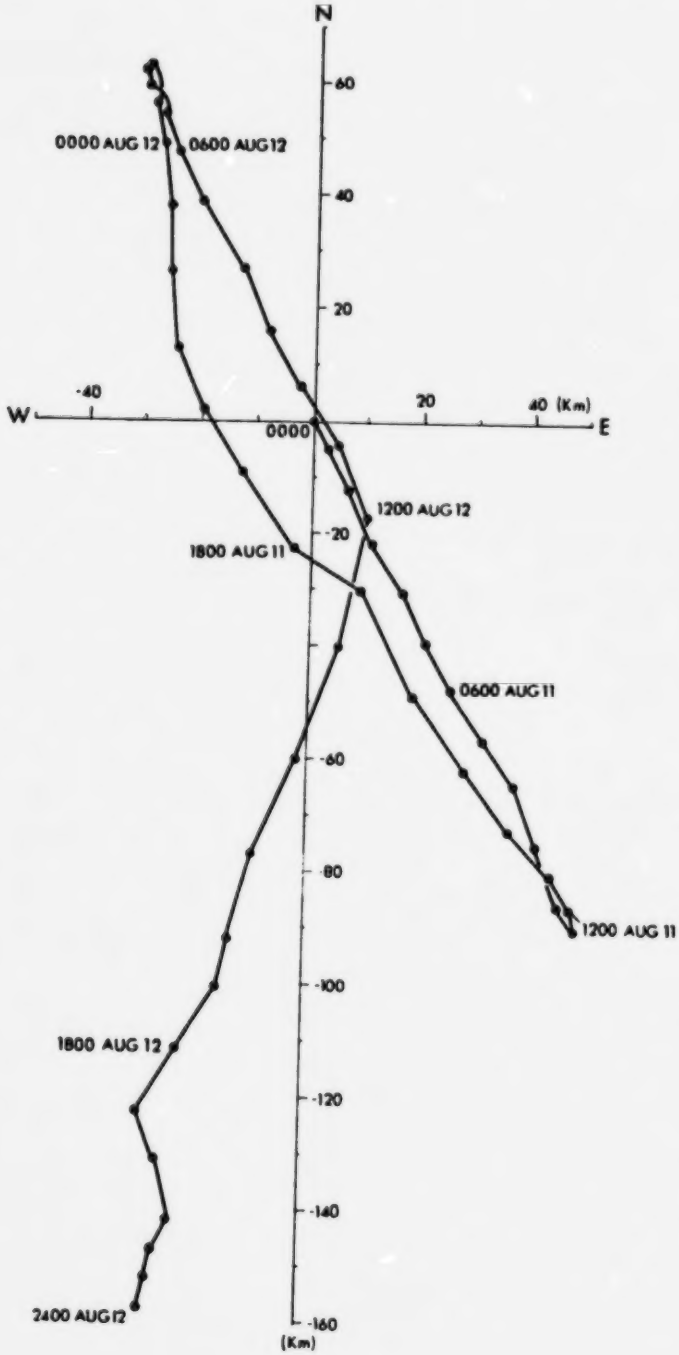

Figure 3.7. Computed trajectories for 13-14 August using UC and SB winds.

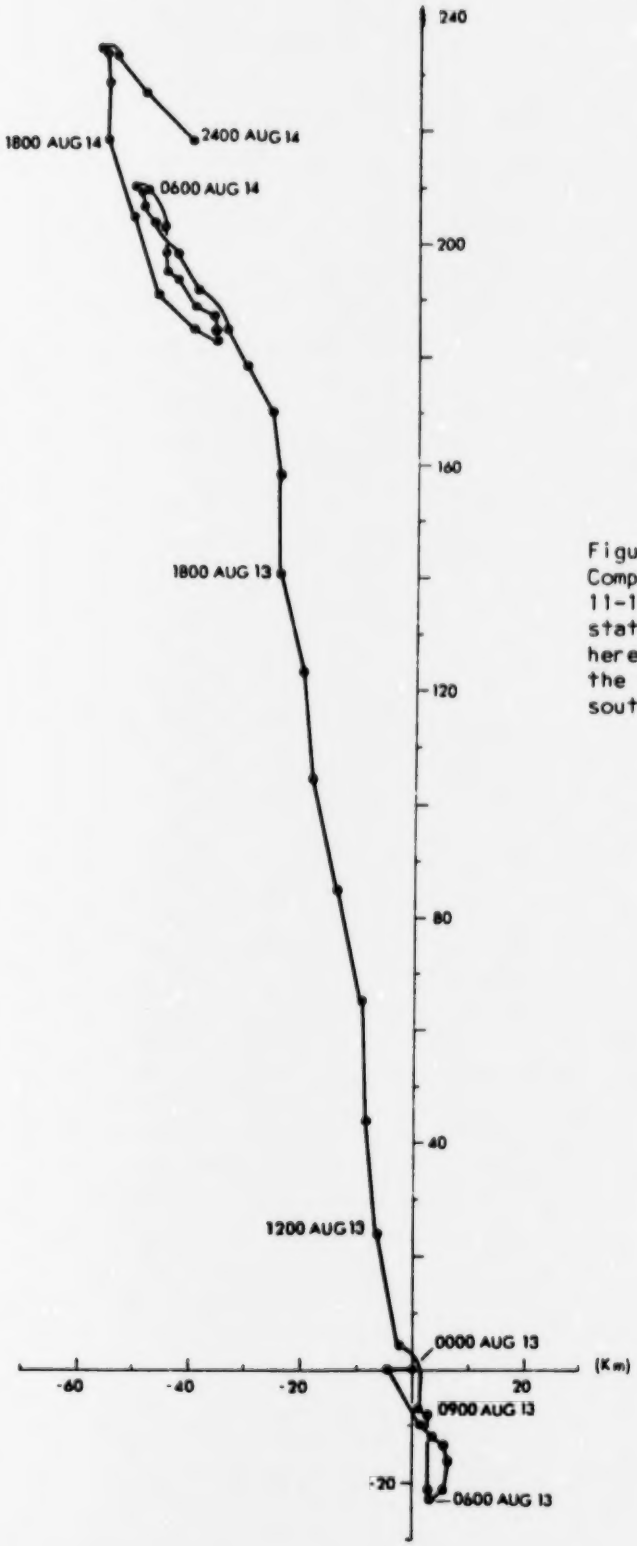

Figure 3.6.
Computed trajectories for 11-12 August using UC and SB stations. Although not shown here, after 1800 on 12 August the trajectory continues in a southeasterly direction.

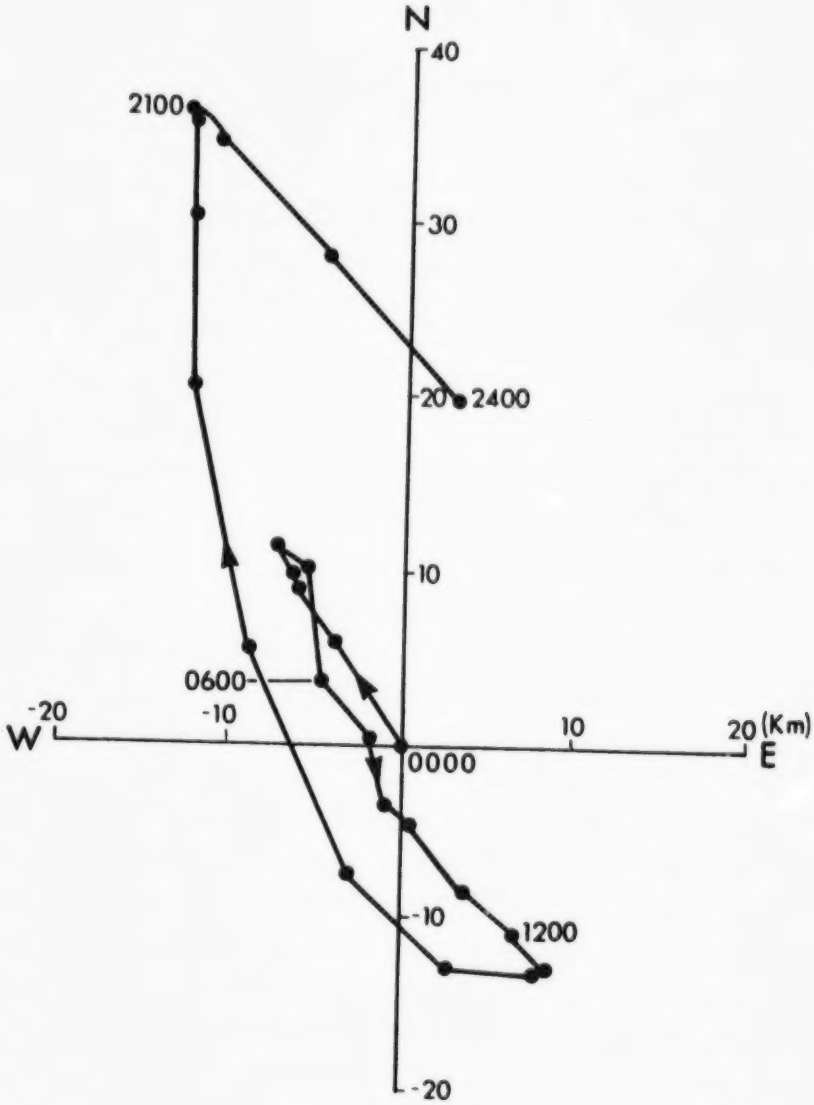

Figure 3.8. Computed trajectories for 14 August using UC and SB station winds.

The trajectories were more complicated on 13 and 14 August. Winds were light and from the northwest until about 0600 on 13 August when they reversed direction and increased in speed to an average of about 5 m/s. The wind speed decreased in the early evening although the direction remained fairly constant from the south. This decrease in speed in the evening may be due to the influence of a valley wind component.

On 14 August (Figure 3.8), the wind flow direction reversed and became down-valley about 0400. Flow directions reversed about 1300 probably due to a valley wind resulting from solar heating. Although the flow direction reversed and became down-valley in the evening, the plotted trajectories do not suggest that a late-evening peak would have occurred over the city.

3.4.2 Meteorology

The behaviour of the winds on these dates reflect the complicated interaction of valley winds and the synoptic pressure gradient. The synoptic flow can cause flow reversals that look similar to a valley wind in the afternoon (27 January) so that interpretations based on limited measurements must be tentative.

The trajectory pattern for this five-day series strongly suggests that on days with significant heating, there is an up-valley forcing during the afternoon hours and a down-valley, or drainage wind, in the evening hours. Whether this flow dominates the synoptic flow, and the exact timing of the wind direction reversals, depends on the heatingcooling rates and the strength of the synoptic flow.

On 10 August, a high in Montana and a low in the central North West Territories were the major features on the surface pressure maps. The pressure gradient decreased as the low moved eastward, allowing the afternoon up-valley flow to develop.

A high tracked across northern Alberta on 11 August; its motion was such that the shift in wind direction in the afternoon could have been the result of the synoptic pressure field alone and should not be taken to indicate a valley-dominated flow. However, relatively higher wind speeds at Calgary, compared with nearby stations, suggest that a valley wind component was contributing to the wind field.

On 12 August, a low-pressure system followed the high of the previous day across northern Alberta. An accompanying frontal system was probably responsible for the slight shift in wind direction at mid-day. The frontal passage was also associated with considerable convective activity and an afternoon thunderstorm was recorded at the airport. Only nine hours of sunshine were recorded compared with about 14 hours on 10 and 11 August.

A second high-pressure system moved across central Alberta on 13 August. Movement of the high was responsible for the shift in wind directions in the early morning of 13 August. The wind records suggest that the afternoon winds were enhanced by a radiational heating-induced valley flow as on 11 August.

The high-pressure system moved eastward into Saskatchewan, but continued to dominate the synoptic flow in Alberta on 14 August. A down-valley flow did however develop in the early-morning hours on 14 August and continued until about noon when flow reversal occurred. The southeasterly winds in the afternoon were probably a combination of valley and synoptic winds, since winds at other area stations were also southeasterly during the entire day.

3.5 28-29 AUGUST CASE STUDY

3.5.1 Trajectories

The trajectory for 28-29 August is plotted in Figure 3.9. Only Springbank and Airport station data were available for this time period. This trajectory shows a flow reversal at 1100 on 28 August. Although not plotted here, the winds blew strongly from the north all day on 29 August and therefore no flow reversal occurred at noon on this latter date.

This figure also indicates that the air which was over the city at about noon on 28 August would have been advected over the city again around 0100 on the 29th. This example is, however, not quite as obvious as the 5 August case; in this case, the indicated trajectory passed several kilometres to the south of the city centre.

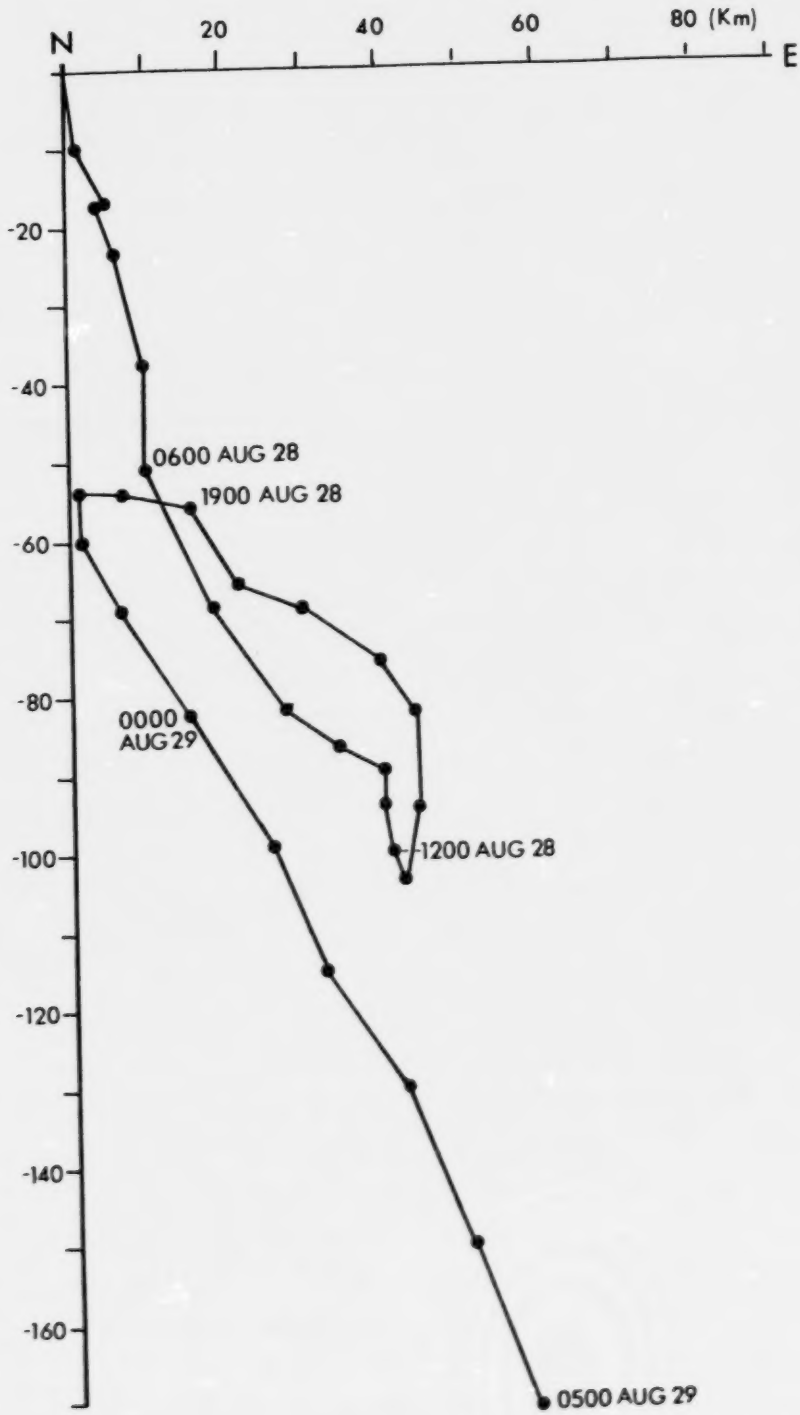

Figure 3.9. Computed trajectories for 28-29 August 1981 using SB and airport station winds.

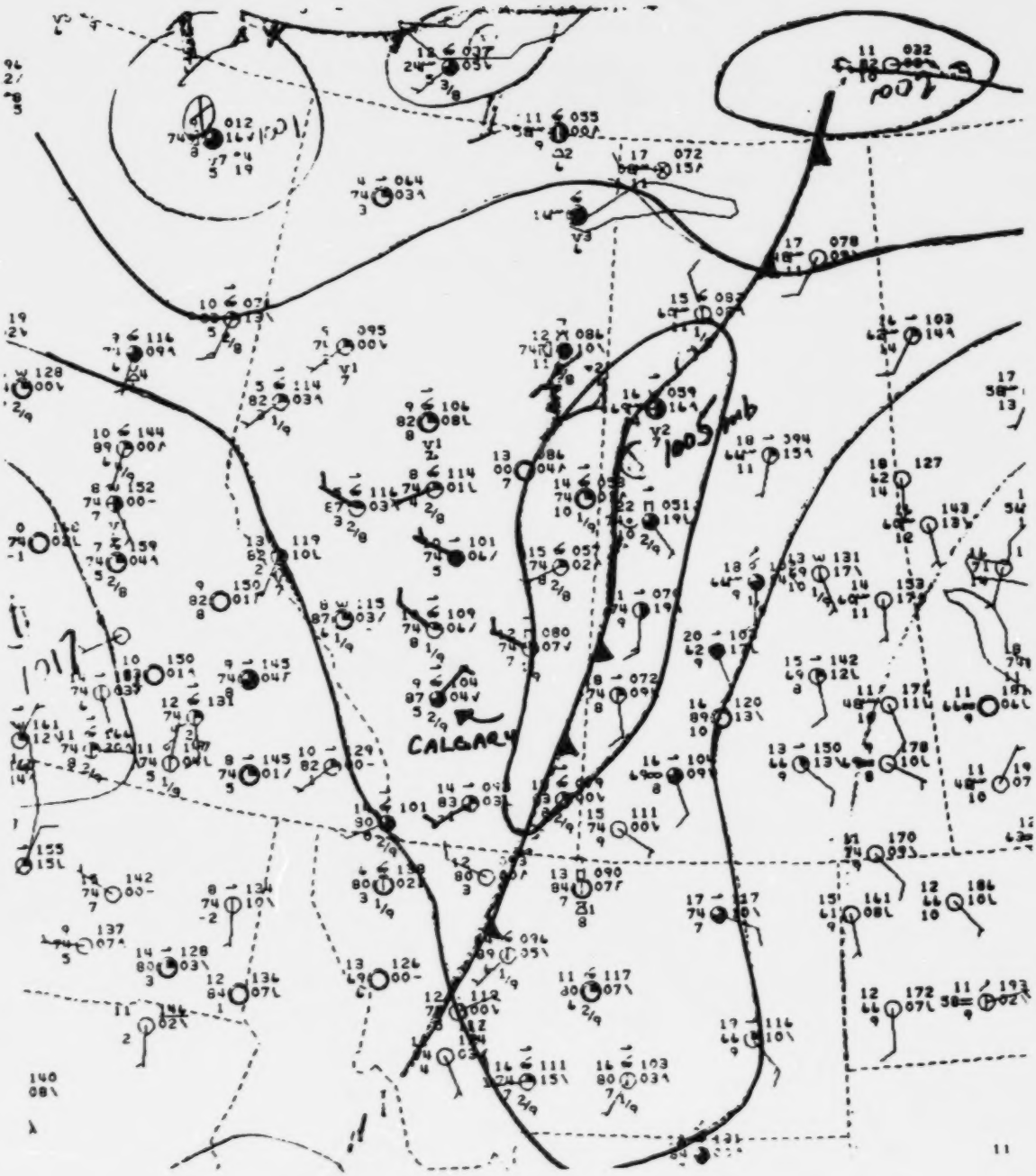

Figure 3.10. Surface pressure map for 1800Z (1100 MST) 28 August 1981. Note difference between Calgary and other area stations.

3.5.2 Meteorology

A frontal disturbance passed over the area on 28 August. Examination of the pressure maps suggests strongly that the flow reversal at noon on 28 August from west to east winds was a valley effect, since the other meteorological stations in the area were indicating westerly winds throughout the afternoon (see Figure 3.10).

The predominant northwesterly flow on 29 August was due to a low-pressure centre which developed over Montana in the frontal system that had passed over the Calgary area on 28 August. There was also considerable cloudiness in the afternoon which would have limited radiational heating. The maximum temperature on 29 August was 18°C compared with 24°C on 28 August.

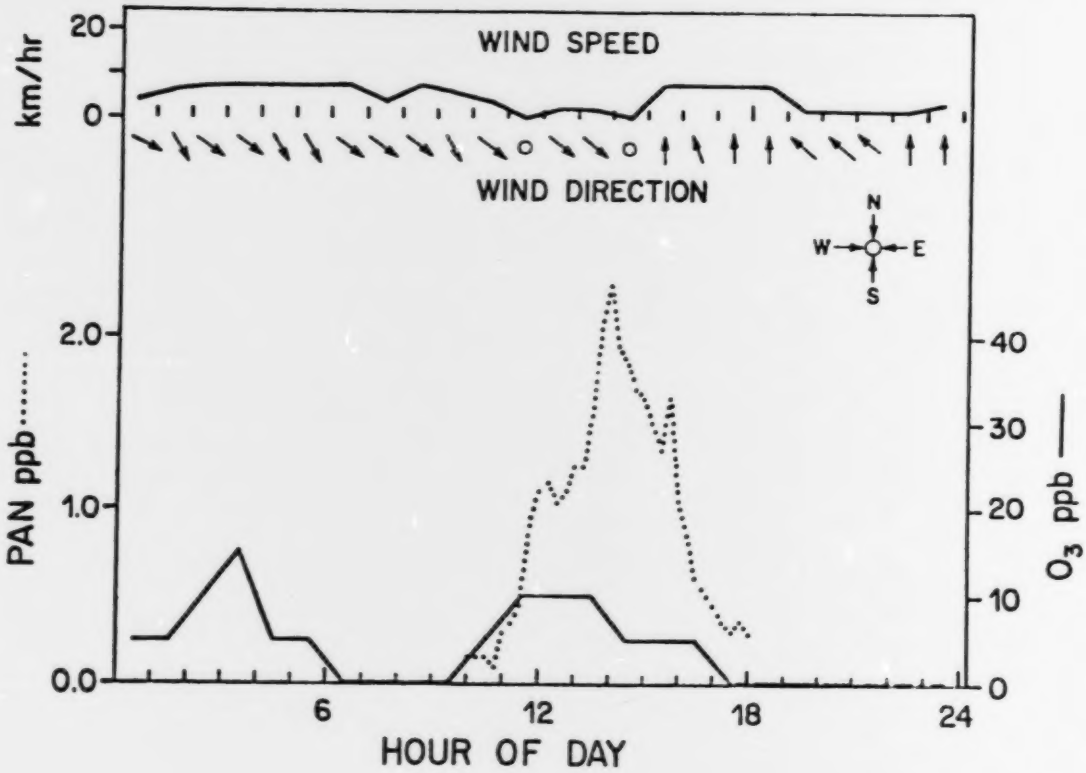

Figure 4.1 PAN and ozone concentrations as observed at the UC station on 27 January 1981 (from Peake and Sandhu, 1982).

4. DISPERSION ESTIMATES

The basis of the methods used to estimate plume spread in the crosswind and vertical directions as a function of downwind direction was given in Section 2.2. In addition to a dependence on σ_y and σ_z (or vertical depth of mixing), the concentration will also depend on the initial wind speed. An approximate expression for peak concentration is:

$$C \alpha Q/(u\sigma_y\sigma_z)$$

where C is concentration, Q is source strength and U is the wind speed at the time of emission.

Pasquill (1974) states that the inverse dependence on U may be masked in some data sets, because the stability will also depend on the wind speed. For example, in convective conditions, as the wind speed decreases, the boundary layer will become more unstable. This typically causes vertical mixing to increase, thus counteracting, to some extent, the affect of the decrease in wind speed.

Complications are also introduced in urban areas, or in areas of complicated terrain. For example, in the city centre, the buildings will seriously distort the flow over what it would be in the surrounding rural areas by channeling of the flow down streets, or by causing small-scale recirculations, etc.

Also, at night, an urban heat island will exist and the strength of the nocturnal inversion will be decreased over the urban centre. This will enhance the rate of mixing in the vertical over what it would be in the surrounding rural areas.

These comments are made to emphasize the uncertainties involved in the dispersion estimates which are given in the following sections. At best, they are order of magnitude estimates only.

4.2 27 JANUARY CASE STUDY

The trajectory for this case study was shown in Figure 3.1. A wind direction reversal from northwesterly to southeasterly occurred at 1400 hours. From Figure 3.1 the prediction would be made that the

UC station should have experienced a peak concentration in PAN after 1400 hours as the air mass moved from downtown over the campus. Figure 4.1 shows the observed PAN and ozone concentration at the UC site on this date (from Peake and Sandhu 1982).

The relatively large concentrations of PAN prior to 1500 hours cannot be explained by the surface wind field. Either the observed PAN is being generated locally, or there is a southeasterly wind aloft, above the surface layer where the winds are northerly, which is advecting PAN from the city centre towards the University.

The sounder record from MRC (Figure 3.3) does indicate the possibility of an increase in the turbulence around noon on 27 January. (Indicated by a darkening of the record at that time). Such an increase in mixing could have brought pollutants aloft down to the surface; however, the signal may indicate only existence of an extraneous source of sound. Some of the August rawinsonde data did show a circulation pattern similar to that required to explain the behaviour of the PAN on the 27th data; however, it is not possible, given the existing data, to choose among the possibilities. It should be restated that the wind speeds were very light and the boundary layer height was less than 150 m. The combination of poor ventilation and a shallow mixed layer may have accounted for the high peak. It is expected, in either case, that downtown concentrations would have been greater than the UC concentrations.

Several other days with wind patterns similar to 27 January occurred in January 1981. Table 4.1 lists these days along with maximum temperatures and duration of sunshine. It might be worthwhile to compare concentration patterns for these days to the 27th. For example, on 26 January, increased wind speeds (relative to the 27th) and a greater boundary layer height (250 m) probably resulted in much lower concentrations than on 27 January.

Table 4.1. January 1981 days with wind patterns similar to 27 January (from the airport records).

DATE	SUNSHINE (hours)	MAXIMUM TEMPERATURE (°C)
2 January	7.7	4.2
3 January	7.8	10.0
14 January	7.5	8.6
23 January	4.7	12.7
26 January	8.1	-2.4
27 January	7.6	-3.8 (1° at UC)

4.2 AUGUST CASE STUDIES

4.2.1 Nighttime PAN Peaks

In two of the case studies, the plotted trajectories indicated that the valley flow could have caused nighttime peaks to occur as daytime air masses were recirculated over the city. The trajectories for these two cases of 5 and 28 August were plotted in Figures 3.4 and 3.9 respectively.

Wind speeds were lighter on 5 August than on 28 August; therefore, it is expected that observed PAN concentrations were higher on the former date. (Boundary layer heights are not available for 5 August).

On 5 August, the plume travel distance between 1200 and 1900 hours (assumed shut-off of convective activity) was about 30 km. From Table 2.1 the increase in σ_y would be about a factor of 2. If the boundary layer height was about 500 m (see Hicks et al. 1976), the increase in vertical plume dimensions was about a factor of 2.5 (see Section 2.2). Therefore it is expected that the night time concentration was about 20% of the mid-day values on 5 August.

On 28 August, the travel distance between 1300 and 1900 hours was about 65 km. The increase in σ_y would be about 2.5. The change in vertical dimensions would also be about a factor of 2.5 (as above), hence, expected evening concentrations would be about 15% of the daytime values.

4.2.2 Daytime Peak Values

Those days in August on which mid-day flow reversal occurred are listed in Table 4.2 along with approximate mean wind speeds. Examination of the available sounder data suggested that the boundary layer heights were between 400-700 m on all of these days.

From Table 4.2, it can be seen that of the total of nine days, two-thirds showed flow reversal. Further with the exception of 10 August, the flow reversal would have caused the air to be advected from downtown over the UC. Given the distances involved (approximately 5 km), it is expected that observed peak concentrations at the UC would have been about 50% of the downtown values. (This assumes that there

Table 4.2. Summary of daytime behaviour for the August case studies.

DATE	WIND REVERSAL	Timing	MEAN WIND (m/s)	MAXIMUM TEMPERATURE UC (°C)	SUNSHINE HOURS
5 Aug.	Yes	1200	1.0 - 1.5	25	13.8
6 Aug.	Yes	1200	1.5 - 2.5	26	13.3
10 Aug.	Yes	1300	1.5 - 2.5	28 (est)	14.0
11 Aug.	Yes	1100	1 - 2	28	13.7
12 Aug.	No	-	4 - 6	26	9.1
13 Aug.	No	-	2. - 4.5	22	11.0
14 Aug.	Yes	1300	1. - 1.5	27	9.2
28 Aug.	Yes	1300	1. - 2.5	23	7.8
29 Aug.	No		3. - 5.	17	6.3

Table 4.3. Relative ranking of August days for pollution potential from highest to lowest.

DAY	COMMENT
5 August	Hard to distinguish between 5 August and 11 August on basis of available data.
11 August	
14 August	
6 August	
10 August	Perhaps 10 August should be higher.
28 August	
13 August	
29 August	29 August ranked below 13 August on basis of mean temperature
12 August	

* These rankings are obviously very crude.

were no significant sources between the downtown area and the campus). However, as was discussed, the peak concentrations on 27 January at the UC occurred prior to the reversal in wind direction.

Table 4.2 also gives the time of flow reversal for each of the August days. PAN peaks at the UC site would have been expected to lag these times by 0 to 2 hours depending on the wind speed.

If the UC peak concentrations occurred earlier than the time of wind direction reversal this implies that: (1) either local sources (near campus) were important; or (2) some form of complicated circulation (above the surface) was entraining air over the downtown area and advecting this air towards the campus where it was then mixed down to the surface by convective activity. (A third possibility is that there was a source in the valley up wind of the city). As mentioned earlier, a conclusion cannot be drawn based on the available data.

It is useful to attempt to rank the case study days in order of expected peak concentrations. This ranking is given in Table 4.3 and is based on wind speed, whether or not flow reversal occurred, and amount of bright sunshine. Obviously it is a very approximate ranking.

5. SUMMARY

As stated in the introduction, the objectives of the study were to:

1. Prepare a description of the meteorology affecting transport and diffusion for the selected case studies; and
2. Construct air-mass trajectories and determine if the nighttime peaks in PAN concentration could be explained by air mass movement.

The most important meteorological parameters affecting transport of pollutants in the case studies was the valley wind circulation. The affect of this circulation on PAN concentrations was enhanced because the circulation typically shifted direction around mid-day at the same time that PAN production might be expected to have been a maximum. The magnitude of the wind speed (or ventilation) also tended toward a minimum value at the same time, which caused concentration values to be further increased. It is fortunate that the boundary layer height rises rapidly after sunrise in the summer months, or PAN concentrations would have been even greater. The observed peak concentration of PAN on any given day will be strongly dependent on the rate of PAN generation and the wind direction shift.

The high concentrations observed on 27 January 1982 were due to a combination of low wind speeds, a limited mixing layer height and relatively high temperature and levels of solar radiation (for January). The timing of the peak PAN concentration on 27 January at the University of Calgary could not be explained with the available data.

The plotted trajectories did suggest that the valley circulation could be responsible for nighttime peaks for two of the case studies: 5-6 August and 28-29 August. A rough estimate of dispersion suggested that the nighttime concentrations should have been about 15-25% of the daytime values. This estimate ignores any affect of continuing photochemical production or deposition. It also assumes that there were no significant sources to the west of Calgary.

If the PAN observed at the University of Calgary was advected from the downtown area, it is expected that the peak concentrations would have been reduced about 50% by vertical mixing between the downtown and the University.

Finally, the plotted wind fields suggest that air from the city can be advected to the front range of the Rockies. Whether or not this represents a serious environmental impact cannot be determined without further study.

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9.6 ANION AND CATION CONCENTRATIONS IN THE CALGARY ATMOSPHERE

9.6.1 Anion and Cation Concentrations in the Atmosphere at the University of Calgary, 1980 November until 1981 February

Anion and cations were measured in the atmosphere at the University of Calgary using high-volume equipment from 1980 November until 1981 February. Results are presented as ug per m^3 of air.

Table 41. Anions and cations collected by high-volume sampler on paper filters, University of Calgary weather station, 1980 November 11 to 1981 February 8 (ug/m^3).

Date	Time	$SO_4^=$	$NO_3^=$	Cl^-	Na^+	NH_4	K^+
80-11-11	0000 to 2400	0.9	6.7	0.5	0.4	3.0	0.2
80-11-12	0000 to 2400	4.5	2.2	0.9	0.7	1.9	1.3
80-11-13	0000 to 2400	1.5	1.5	0.5	0.6	0.9	0.4
80-11-14	0000 to 2400	3.8	-	0.7	0.7	5.4	0.5
80-11-15	0000 to 2400	2.5	1.4	1.1	0.7	0.1	0.2
80-11-16	0000 to 2400	-	-	-	-	-	-
80-11-17	0000 to 2400	1.3	-	0.9	0.3	0.8	0.4
80-11-18	0000 to 1900	0.9	0.6	0.2	0.2	0.1	0.5
80-11-18/19	1900 to 0700	1.5	1.0	1.8	0.6	0.8	0.4
80-11-19	0700 to 1900	1.0	0.8	0.3	0.6	1.0	1.0
80-11-19/20	1900 to 0700	0.6	0.9	0.6	0.5	0.9	0.2
80-11-20	0700 to 1900	1.7	0.7	3.5	1.1	0.6	0.3
80-11-20/21	1900 to 0700	1.5	0.8	2.3	0.5	0.7	0.1
80-11-21	0700 to 1900	1.5	0.7	1.2	0.4	0.6	0.6
80-11-21/22	1900 to 0700	1.1	0.5	0.8	1.0	0.5	0.8
80-11-22	0700 to 1900	2.4	2.9	7.1	2.1	1.4	0.6
80-11-22/23	1900 to 0700	0.4	0.5	5.3	0.9	0.7	0.3
80-11-23	0700 to 1900	0.2	0.7	7.0	1.6	0.7	0.2
80-11-23/24	1900 to 0700	1.2	0.8	3.7	0.8	0.7	0.3
80-11-24	0700 to 1900	2.3	1.6	10.3	2.3	2.0	0.4
80-11-24/25	1900 to 0700	1.6	1.6	7.5	0.7	0.8	0.8
80-11-25	0700 to 1900	0.9	0.2	5.7	0.9	0.8	0.2
80-11-25/26	1900 to 0700	0.7	0.3	2.6	1.9	1.0	0.2
80-11-26	0700 to 1900	1.3	0.6	6.7	2.1	0.8	0.4
80-11-26/27	1900 to 0700	1.3	1.3	9.3	2.5	0.3	0.1
80-11-27	0700 to 1900	2.3	3.6	10.0	4.4	2.9	0.3
80-11-27/28	1900 to 0700	0.4	0.3	7.1	0.7	0.9	0.6
80-11-28	0700 to 1900	0.9	0.4	6.7	2.0	0.5	0.2

continued...

Table 41. Continued.

Date	Time	$SO_4^=$	$NO_3^=$	Cl^-	Na^+	NH_4	K^+
80-11-28/29	1900 to 0700	18.5	1.2	3.8	0.9	2.0	0.3
80-11-29	0700 to 1900	2.2	2.2	1.0	0.4	0.3	0.2
80-11-29/30	1900 to 0700	2.5	2.2	-	0.3	1.0	0.3
80-11-30	0700 to 1900	1.4	2.1	1.0	0.3	1.3	0.4
80-11-30/01	1900 to 0700	2.5	2.4	0.7	0.3	1.5	0.2
80-12-01	0700 to 1900	7.9	3.0	0.3	0.6	2.6	0.2
80-12-01/02	1900 to 0700	6.0	4.5	0.9	0.4	2.8	0.2
80-12-02	0700 to 1900	1.8	2.1	0.3	0.2	1.5	0.1
80-12-02/03	1900 to 0700	2.5	2.2	0.5	0.9	2.8	0.5
80-12-03	0700 to 1900	1.6	1.7	0.2	0.2	1.2	0.1
80-12-03/04	1900 to 0700	0	0	0	0	0	0
80-12-04	0700 to 1900	3.1	2.0	0.7	0.4	2.6	0.4
80-12-04/05	1900 to 0700	1.3	1.0	0.3	0.1	1.0	0.1
80-12-05	0700 to 1900	2.1	1.1	0.5	0.1	1.1	0.1
80-12-05/06	1900 to 0700	2.8	1.7	0.2	0.2	1.6	0.1
80-12-06	0700 to 1900	3.7	2.3	0.3	0.2	1.5	0.3
80-12-06/07	1900 to 0700	1.3	1.2	0.4	0.2	1.4	0.1
80-12-07	0700 to 1900	0.8	0.4	0.2	0.1	0.8	0.1
80-12-07/08	1900 to 0700	0.8	0.6	0.8	0.5	1.4	0.4
80-12-08	0700 to 1900	3.3	2.2	1.1	0.9	1.3	0.3
80-12-08/09	1900 to 0700	10.4	6.5	0.2	0.5	3.4	0.3
80-12-09	0700 to 1900	2.4	2.0	0.3	0.2	1.4	0.1
80-12-09/10	1900 to 0700	13.9	3.4	0.3	0.2	1.9	0.1
80-12-10	0700 to 1900	5.0	4.5	2.1	0.4	2.3	0.7
80-12-10/11	1900 to 0700	1.4	1.7	1.2	0.6	1.3	0.3
80-12-11	0700 to 1900	0.5	0.2	1.4	0.8	0.6	0.3
80-12-11/12	1900 to 0700	0.3	0.2	0.6	0.8	0.6	0.1
80-12-12	0700 to 1900	0.8	0.9	4.2	1.3	0.9	0.2

continued...

Table 41. Continued.

Date	Time	$SO_4^=$	$NO_3^=$	Cl^-	Na^+	NH_4	K^+
80-12-12/13	1900 to 1900	0.5	0.6	1.8	0.3	0.4	0.3
80-12-13/14	1900 to 1900	0.4	0.2	0.6	0.4	0.4	0.1
80-12-14/15	1900 to 1900	0.3	0.2	0.9	0.5	0.4	0.1
80-12-15/16	1900 to 0700	0.3	0.3	0.6	0.1	0.9	0.2
80-12-16	0700 to 1900	0.3	0.3	0.8	0.5	0.7	0.1
80-12-16/17	1900 to 0700	2.0	1.1	0.5	0.3	1.0	2.8
80-12-17	0700 to 1900	1.1	0.5	0.003	0.2	0.6	0.2
80-12-17/18	1900 to 0700	1.3	0.5	1.9	0.3	0.8	0.3
80-12-18	0700 to 1900	1.3	0.4	0.3	1.4	1.2	0.2
80-12-18/19	1900 to 0700	3.6	2.4	0.1	0.7	2.5	0.3
80-12-19	0700 to 1900	10.2	3.4	-	0.9	5.6	2.3
80-12-19/20	1900 to 0700	4.8	4.1	-	0.3	2.3	0.2
80-12-20	0700 to 1900	0.2	0.07	-	0.2	0.6	0.2
80-12-20/21	1900 to 0700	9.5	3.5	0.1	0.5	3.2	0.2
80-12-21/22	0700 to 0700	9.9	3.6	-	0.4	0.8	0.2
80-12-22	0700 to 1900	3.9	4.1	0.0	0.5	2.3	0.3
80-12-22/23	1900 to 0700	2.7	1.8	0.0	0.2	1.2	0.1
80-12-23 to 81-01-02		Christmas					
81-01-02	0800 to 1900	1.4	1.9	1.2	1.0	1.6	0.4
81-01-02/03	1900 to 0700	0.8	0.8	1.0	0.4	1.0	0.4
81-01-03	0700 to 1900	0.6	0.3	0.5	0.4	0.9	0.2
81-01-03/04	1900 to 0700	-	-	-	-	-	-
81-01-04	0700 to 1900	0.6	0.4	0.2	0.4	1.0	0.3
81-01-04/05	1900 to 0700	0.4	0.3	0.1	0.2	1.0	0.2
81-01-05	0700 to 1900	0.5	0.2	0.6	0.4	1.4	0.3
81-01-05/06	1900 to 0700	0.7	0.9	0.3	0.2	1.0	0.2
81-01-06	0700 to 1900	3.9	2.4	1.2	0.7	1.8	1.7

continued...

Table 41. Concluded.

Date	Time	$SO_4^=$	$NO_3^=$	Cl^-	Na^+	NH_4	K^+
81-01-06/07	1900 to 0700	1.2	0.4	1.1	0.6	1.4	0.3
81-01-07	0700 to 1900	0.6	0.1	0.5	0.6	0.9	0.5
81-01-07/08	1900 to 0700	0.7	0.9	0.9	0.4	1.2	0.2
81-01-08	0700 to 1900	3.1	1.6	0.6	0.4	0.8	3.3
81-01-08/09	1900 to 0700	22.5	0.8	0.0	0.6	1.7	0.6
81-01-09	0700 to 1900	2.6	3.5	0.6	0.6	1.7	0.7
81-01-09/10	1900 to 0700	0.6	0.3	0.8	0.4	1.2	0.4
81-01-10	0700 to 1900	1.0	0.8	1.8	0.7	1.6	0.4
81-01-10/11	1900 to 0700	0.4	0.2	0.5	0.3	1.1	0.7
81-01-11	0700 to 1900	0.5	0.3	0.9	0.4	1.5	0.2
81-01-11/12	1900 to 0700	0.4	0.4	0.5	0.3	0.8	0.2
81-01-12	0700 to 1900	0.6	0.3	1.5	0.7	1.8	0.4
81-01-12/13	1900 to 0700	-	-	-	-	-	-
81-01-13	0700 to 1900	0.5	0.3	0.7	0.4	1.0	0.3
81-01-13/14	1900 to 0700	1.0	0.8	0.7	0.8	1.9	0.6
81-01-14	0700 to 1900	0.3	0.1	0	0.3	1.0	0.2
81-01-14/15	1900 to 0700	1.6	0.9	1.5	0.5	1.4	0.3
81-01-15	0700 to 1900	5.5	3.0	0.2	0.8	2.8	0.4
81-01-15/16	1900 to 0700	0.9	0.6	0.2	0.5	3.2	8.8
81-01-16	0700 to 1900	1.7	3.7	1.4	2.4	3.6	0.5
81-01-16/17	1900 to 1900	2.2	2.2	1.3	1.2	1.9	0.4
81-01-17/18	1900 to 1900	0.5	0.1	0.5	0.7	1.2	0.1
81-01-18/19	1900 to 1900	0.8	0.9	1.0	0.6	1.0	0.2
81-01-19/20	1900 to 1900	0.8	0.1	0.9	1.1	1.3	0.3
81-01-20/21	1900 to 0700	0.4	0.3	-	0.5	1.0	0.2
81-01-21	0700 to 1900	0.7	0.6	0.3	0.3	0.9	0.2
81-01-21/22	1900 to 0700	0.7	0.5	0	1.0	1.1	0.5
81-01-22	0700 to 1900	0.5	0	0	1.1	1.1	0.3

continued...

Table 41. Continued.

Date	Time	$SO_4^=$	$NO_3^=$	Cl^-	Na^+	NH_4	K^+
81-01-22/23	1900 to 0700	0.4	0	0	0.8	1.2	0.3
81-01-23	0700 to 1900	0.6	0.2	0.2	1.0	0.9	0.1
81-01-23/24	1900 to 0700	2.0	2.5	0.7	1.3	1.2	1.7
81-01-24	0700 to 1900	0.5	0.3	0.2	0.4	1.2	0.3
81-01-24/25	1900 to 0700	0.4	0.3	0	1.2	0.7	0.5
81-01-25	0700 to 1900	0.4	0.2	0	1.6	0.8	0.1
81-01-25/26	1900 to 0700	1.5	1.4	0	0.5	1.5	0.2
81-01-26	0700 to 1900	1.4	1.2	0.2	2.7	1.2	0.2
81-01-26/27	1900 to 0700	12.9	4.0	0.2	2.9	4.0	4.2
81-01-27	0700 to 1900	12.4	11.0	3.3	2.8	3.3	0.6
81-01-27/28	1900 to 0700	44.0	10.7	1.2	1.3	8.6	1.2
81-01-28	0700 to 1900	6.1	4.4	0.5	3.6	2.6	2.4
81-01-28/29	1900 to 0700	6.8	4.4	0	0.6	2.9	0.4
81-01-29	0700 to 1900	11.6	9.0	1.1	1.3	5.0	0.5
81-01-29/30	1900 to 0700	15.3	9.8	0.8	0.9	5.6	0.6
81-01-30	0700 to 1900	14.1	10.1	2.5	2.8	5.4	3.4
81-01-30/31	1900 to 0700	3.8	1.8	0.5	1.1	2.1	0.2
81-01-31	0700 to 1900	6.6	3.6	2.4	1.1	2.4	0.3
81-01-31/01	1900 to 0700	2.0	1.9	0.7	0.6	1.8	0.3
81-02-01	0700 to 1900	14.3	5.1	1.3	1.2	4.5	1.1
81-02-01/02	1900 to 0700	2.1	1.7	1.2	2.0	1.7	0.4
81-02-02	0700 to 1900	0.8	0.5	0.7	1.3	1.2	0.2
81-02-02/03	1900 to 0700	0.7	0.5	2.8	0.6	1.2	0.3
81-02-03	0700 to 1900	1.2	1.1	1.4	0.9	1.5	0.3
81-02-03/04	1900 to 0700	1.3	2.2	1.2	1.8	1.6	0.2
81-02-04	0700 to 1900	0.6	0.4	1.6	2.7	1.2	0.3
81-02-04/05	1900 to 0700	1.2	1.0	2.3	1.1	1.6	0.2
81-02-05	0700 to 1900	0.8	0.8	2.8	1.4	1.3	0.6

continued...

Table 41. Concluded.

Date	Time	$SO_4^=$	$NO_3^=$	Cl^-	Na^+	NH_4	K^+
81-02-05/06	1900 to 0700	0.3	0.3	0.4	0.4	1.2	0.1
81-02-06	0700 to 1900	4.0	1.7	6.7	2.4	2.2	0.7
81-02-06/07	1900 to 0700	1.6	0.4	4.0	1.3	1.3	0.2
81-02-07	0700 to 1900	2.2	0.7	6.1	2.4	1.4	0.4
81-02-07/08	1900 to 0700	1.6	0.3	2.7	1.3	1.1	0.1
81-02-08	0700 to 1900	3.6	1.0	8.9	3.0	1.7	1.0

9.6.2 Nitrate Concentrations at the University of Calgary, 1982 June 1 to August 31

Particulate nitrate was collected on a 2.0 u Teflon filter and volatile nitrate on a 1.0 u nylon filter at the University of Calgary sampling site. Total nitrate is the sum of the nitrate collected on the two filters. Samples were collected from 1982 June 1 to August 31. Results are presented as ug of nitrate per m^3 of air.

Table 42. Total nitrate, teflon filter-collected nitrate, and nylon (backup) filter collected nitrate (ug/m^3), University of Calgary, 1982 June 1 to August 31.

Date	Period	Total	Teflon	Nylon	Ratio Teflon/Nylon
82-06-01	0834 to 1150	6.22	3.71	2.51	1.5
	1155 to 1617	1.37	0.90	0.47	1.9
82-06-01/02	1621 to 0830	0.72	0.29	0.43	0.67
82-06-02	0833 to 1158	0.68	0.52	0.16	3.3
	1201 to 1601	1.22	0.81	0.41	2.0
82-06-02/03	1602 to 0842	0.25	0.17	0.08	2.1
82-06-03	0846 to 1338	0.85	0.48	0.37	1.3
	1340 to 1556	0.62	0.22	0.40	0.55
82-06-03/04	1558 to 0840	0.91	0.74	0.17	4.4
82-06-04	0943 to 1326	0.81	0.52	0.29	1.8
	1220 to 1614	0.52	0.32	0.20	1.6
82-06-07/08	1612 to 0844	0.32	0.31	0.01	31
82-06-08	0846 to 1311	0.23	0.09	0.14	0.64
	1316 to 1700	0.26	0.09	0.17	0.53
82-06-08/09	1705 to 0844	0.19	0.08	0.11	0.73
82-06-09	0847 to 1620	1.15	0.74	0.41	1.8
82-06-09/10	1623 to 0821	1.24	1.01	0.23	4.4
	0824 to 1322	1.19	0.46	0.73	0.63
	1325 to 1616	1.44	0.41	1.03	0.39
82-06-10/11	1619 to 0828	0.22	0.09	0.13	0.69
82-06-11	0830 to 1148	1.99	1.60	0.39	4.1
	1634 to 2030	0.43	0.15	0.28	0.54
82-06-14	0800 to 1218	1.20	0.51	0.69	0.74
	1218 to 1620	0.61	0.24	0.37	0.65

continued...

Table 42. Continued.

Date	Period	Total	Teflon	Nylon	Ratio Teflon/Nylon
82-06-14/15	1620 to 0800	0.70	0.36	0.34	1.1
82-06-15	0802 to 1409	0.82	0.30	0.52	0.58
	1410 to 1605	1.18	0.63	0.55	1.2
82-06-15/16	1611 to 0750	no data - heavy rain			
82-06-16	0750 to 1153	0.37	0.37	0.0	0.37
	1155 to 1605	0.48	0.10	0.38	0.36
82-06-16/17	1608 to 0823	0.18	0.07	0.11	0.64
82-06-17	0820 to 1156	0.27	0.01	0.26	0.04
	1158 to 1600	0.31	0.09	0.22	0.41
82-06-17/18	1605 to 0818	0.93	0.84	0.09	9.3
82-06-18	0800 to 1150	0.31	0.06	0.25	0.24
	1155 to 1626	1.98	0.47	1.51	0.31
82-06-21	0855 to 1154	0.59	0.04	0.55	0.07
	1156 to 1602	0.81	0.31	0.50	0.62
82-06-21/22	1605 to 0828	1.14	0.09	0.24	0.38
82-06-22	0830 to 1157	0.15	0.06	0.09	0.67
	1159 to 1613	0.31	0.15	0.16	0.94
82-06-11/23	1615 to 0827	0.05	0.03	0.02	1.5
82-06-23	0828 to 1150	-	0.48	-	-
	1153 to 1557	0.94	0.64	0.30	2.1
82-06-24	0829 to 1151	1.38	1.35	0.03	45.0
	1153 to 1555	0.87	0.54	0.33	1.6
82-06-24/25	1557 to 0818	0.22	0.17	0.05	3.4
82-06-25	0820 to 1154	0.22	0.09	0.13	0.69
	1156 to 1600	0.08	0.68	0.15	4.5

continued...

Table 42. Continued.

Date	Period	Total	Teflon	Nylon	Ratio Teflon/Nylon
82-06-28	0845 to 1153	0.54	0.27	0.27	1.0
	1155 to 1656	0.15	0.11	0.04	2.8
82-06-28/29	1658 to 0830	0.21	0.18	0.03	6.0
82-06-29	0833 to 1152	0.15	0.09	0.06	1.5
	1155 to 1553	1.12	1.03	0.09	11.0
82-06-29/30	1555 to 0830	0.17	0.15	0.02	7.5
82-06-30	0832 to 1156	0.14	0.06	0.08	0.75
82-07-05	0850 to 1150	0.08	0.04	0.04	1.0
	1152 to 1600	0.07	0.03	0.04	0.75
82-07-05/06	1600 to 0822	0.03	0.01	0.02	0.50
82-07-06	0824 to 1205	0.22	0.05	0.17	0.29
	1205 to 1555	0.10	0.02	0.08	0.25
82-07-07	0840 to 1200	0.24	0.05	0.19	0.26
	1200 to 1550	0.93	0.70	0.23	3.0
82-07-07/08	1551 to 0827	0.43	0.40	0.03	13.0
82-07-08	0830 to 1314	1.01	0.82	0.19	4.3
82-07-12/13	1645 to 0840	0.62	0.51	0.11	4.5
82-07-13	0850 to 1300	1.18	0.66	0.52	1.3
	1300 to 1715	-	0.10	-	-
82-07-13/14	1715 to 0830	0.13	0.04	0.09	0.44
82-07-14	0830 to 1330	0.41	0.01	0.40	0.02
	1330 to 1630	0.09	0.00	0.09	0.00
82-07-15	0830 to 1300	0.01	0.01	0.00	00.0
82-07-15	1300 to 1717	0.27	0.00	0.27	0.00

continued...

Table 42. Continued.

Date	Period	Total	Teflon	Nylon	Ratio Teflon/Nylon
82-07-15/16	1720 to 0819	0.11	0.04	0.07	0.57
82-07-16	0829 to 1230	0.19	0.11	0.08	1.4
	1230 to 1615	0.00	0.00	0.00	0.00
82-07-19	0831 to 1155	0.00	0.00	0.00	0.00
82-07-19/20	1200 to 0834	0.24	0.21	0.03	7.0
82-07-20	0836 to 1155	0.00	0.00	0.00	0.00
	1155 to 1556	0.00	0.00	0.00	0.00
82-07-20/21	1558 to 0835	0.03	0.03	0.00	0.00
82-07-21	0837 to 1153	0.00	0.00	0.00	0.00
	1155 to 1556	1.08	0.83	0.25	3.3
82-07-21/22	1558 to 0820	0.09	0.00	0.09	0.00
82-07-22	0831 to 1152	0.00	0.00	0.00	0.00
	1154 to 1613	0.00	0.00	0.00	0.00
82-07-22/23	1615 to 0835	-	0.02	-	-
82-07-23	0835 to 1151	0.04	0.00	0.04	0.00
	1152 to 1600	0.12	0.04	0.08	0.50
82-07-26	0828 to 1205	0.08	0.04	0.04	1.0
	1205 to 1557	0.30	0.11	0.19	0.58
82-07-26/27	1559 to 0836	0.20	0.09	0.11	0.82
82-07-27	0838 to 1151	0.85	0.38	0.47	0.90
	1153 to 1553	0.30	0.04	0.26	0.15
82-07-27/28	1554 to 0830	0.14	0.05	0.09	0.56
82-07-28	0831 to 1153	0.39	0.27	0.12	2.2
	1154 to 1553	2.55	1.71	0.84	2.0
82-07-28/29	1555 to 0817	0.55	0.37	0.18	2.1

continued...

Table 42. Continued.

Date	Period	Total	Teflon	Nylon	Ratio Teflon/Nylon
82-07-29	0818 to 1153	2.23	1.73	0.50	3.5
	1154 to 1554	0.08	0.08	0.00-	0.00
82-07-29/30	1555 to 0833	0.55	0.20	0.35	0.57
82-07-30	0834 to 1153	0.04	0.04	0.00	0.00
	1154 to 1400	0.43	0.16	0.27	0.59
82-08-03	0819 to 1152	0.85	0.35	0.50	0.70
	1153 to 1605	1.18	0.34	0.84	0.40
82-08-03/04	1606 to 0825	0.09	0.00	0.09	0.00
82-08-04	0826 to 1153	0.40	0.15	0.25	0.60
	1154 to 1554	0.27	0.00	0.27	0.00
82-08-04/05	1554 to 0836	0.25	0.03	0.12	0.25
82-08-05	0837 to 1152	0.16	6.16	0.00	0.00
	1153 to 1600	0.36	0.04	0.32	0.12
82-08-05/06	1601 to 0820	0.15	0.04	0.11	0.36
82-08-06	0821 to 1152	0.33	0.00	0.33	0.00
	1153 to 1651	0.00	0.00	0.00	0.00
82-08-09	1151 to 1656	0.25	0.00	0.25	0.00
82-08-09/10	1657 to 0827	0.12	0.12	0.00	0.00
82-08-10	0828 to 1157	0.87	0.01	0.86	0.01
	1156 to 1605	0.00	0.00	0.00	0.00
82-08-10/11	1606 to 0815	0.30	0.02	0.28	0.07
82-08-11	0815 to 1152	0.30	0.00	0.30	0.00
	1153 to 1600	0.01	0.00	0.01	0.00
82-08-11/12	1602 to 0828	0.05	0.04	0.01	4.0

continued...

Table 42. Continued.

Date	Period	Total	Teflon	Nylon	Ratio Teflon/Nylon
82-08-12	0829 to 1152	0.00	0.00	0.00	0.00
	1153 to 1556	0.00	0.00	0.00	0.00
82-08-12/13	1557 to 0833	0.05	0.03	0.02	1.5
82-08-13	0834 to 1153	0.00	0.00	0.00	0.00
	1154 to 1552	0.13	0.00	0.13	0.00
82-08-16	0905 to 1303	0.42	0.42	0.00	0.00
	1304 to 1601	1.22	0.22	1.00	0.22
82-08-16/17	1601 to 0818	0.18	0.04	0.14	0.28
82-08-17	1019 to 1200	0.79	0.60	0.19	3.2
	1202 to 1558	1.87	0.30	1.57	0.47
82-08-17/18	1600 to 0825	0.09	0.02	0.07	0.28
82-08-18	0833 to 1155	0.10	0.00	0.10	0.0
	1200 to 1601	0.28	0.00	0.28	0.0
82-08-18/19	1607 to 0800	0.42	0.28	0.14	2.0
82-08-19	0800 to 1205	0.15	0.11	0.04	2.7
	1209 to 1601	0.17	0.00	0.17	0.0
82-08-19/20	1608 to 0830	0.12	0.05	0.07	0.71
82-08-20	0830 to 1153	0.63	0.19	0.44	0.43
	1155 to 1602	0.27	0.15	0.12	1.2
82-08-23	0840 to 1153	0.02	0.02	0.00	-
	1155 to 1600	-	0.0	-	-
82-08-23/24	1604 to 0820	0.05	0.02	0.03	0.67
82-08-24	0825 to 1150	0.03	0.0	0.03	0.0
	1145 to 1600		0.20		-

9.7 NITRATE AND NITRIC ACID IN THE KANANASKIS VALLEY

Particulate nitrate was collected with low-volume sampling equipment (7 L per minute) on Teflon filters, and volatile nitrate (nitric acid) was collected on nylon filters during August of 1982 at the Kananaskis Valley sampling site. Total nitrate is the sum of the nitrate collected on the two types of filters. Results are presented as ug of nitrate per m^3 of air.

Table 43. Total nitrate, Teflon filter-collected nitrate, and nylon (backup) filter-collected nitrate (ug/m^3), Kananaskis Valley, 1982 August 2 to September 3.

Date	Period	Total	Nylon	Teflon	Ratio Teflon/Nylon
82-08-02/03	1700 to 0500	0.29	0.18	0.11	0.61
82-08-03	0500 to 1700	0.17	0.13	0.04	0.31
82-08-03/04	1700 to 0500	0.37	0.27	0.10	0.37
82-08-04	0500 to 1700	0.23	0.13	0.10	0.77
82-08-04/05	1700 to 0500	0.10	0.03	0.07	2.33
82-08-05	0500 to 1700	0.34	0.13	0.21	1.62
82-08-05/06	1700 to 0500	0.13	0.03	0.10	3.33
82-08-06	0500 to 1700	0.20	0.10	0.10	1.00
82-08-06/07	1700 to 0500	0.11	0.02	0.09	4.50
82-08-07	0500 to 1700	2.08	0.97	1.11	1.14
82-08-07/08	1700 to 0500	1.07	0.85	0.22	0.26
82-08-08	0500 to 1700	0.55	0.26	0.29	1.12
82-08-08/09	1700 to 0500	0.16	0.07	0.09	1.29
82-08-09	0500 to 1700	0.62	0.19	0.43	2.26
82-08-09/10	1700 to 0500	0.40	0.21	0.19	0.90
82-08-10	0500 to 1700	0.51	0.35	0.16	0.46
82-08-10/11	0700 to 0500	0.37	0.14	0.23	1.64
82-08-11	0500 to 1700	0.67	0.43	0.24	0.56
82-08-11/12	1700 to 0500	0.53	0.37	0.16	0.43
82-08-12	0500 to 1700	0.78	0.64	0.14	0.22
82-08-12/13	1700 to 0500	0.92	0.73	0.19	0.26
82-08-13	0500 to 1700	0.43	0.20	0.23	1.15
82-08-13/14	1700 to 0500				
82-08-14	0500 to 1700	1.24	0.76	0.48	0.63
82-08-14/15	1700 to 0500	0.57	0.42	0.15	0.36
82-08-15	0500 to 1700	0.86	0.14	0.72	5.14
82-08-15/16	1700 to 0500	0.37	0.23	0.14	0.61
82-08-16	0500 to 1700	0.68	0.29	0.39	1.34

continued...

Table 43. Continued.

Date	Period	Total	Nylon	Teflon	Ratio Teflon/Nylon
82-08-16/17	1700 to 0500	0.17	0.09	0.08	0.89
82-08-17	0500 to 1700	0.33	0.20	0.13	0.65
82-08-17/18	1700 to 0500	0.42	0.26	0.16	0.62
82-08-18	0500 to 1700	0.11	0.11	0	0
82-08-18/19	1700 to 0500	0.27	0.24	0.03	0.13
82-08-19	0500 to 1700	0.13	0.13	0	0
82-08-19/20	1700 to 0500	0.33	0.25	0.08	0.32
82-08-20	0500 to 1700	0.25	0.25	0	0
82-08-20/21	1700 to 0500	0.19	0.09	0.10	1.11
82-08-21	0500 to 1700	0.27	0.23	0.04	0.17
82-08-21/22	1700 to 0500	0.16	0.16	0	0
82-08-22	0500 to 1700	0.13	0.09	0.04	0.44
82-08-22/23	1700 to 0500	0.17	0.13	0.04	0.31
82-08-23	0500 to 1700	0.13	0.13	0	0
82-08-23/24	1700 to 0500	0.09	0	0.09	0
82-08-24	0500 to 1700	0.27	0.15	0.12	0.80
82-08-24/25	1700 to 0500	0.59	0.49	0.10	0.20
82-08-25	0500 to 1700	0.18	0.18	0	0
82-08-25/26	1700 to 0500	0.18	0.09	0.09	1.00
82-08-26	0500 to 1700	0.14	0.11	0.03	0.27
82-08-26/27	1700 to 0500	0.16	0.16	0	0
82-08-27	0500 to 1700	0.35	0.32	0.03	0.09
82-08-27/28	1700 to 0500	0.12	0.04	0.08	2.00
82-08-28	0500 to 1700	0.18	0.13	0.05	0.38
82-08-28/29	1700 to 0500	0.27	0.18	0.09	0.50
82-08-29	0500 to 1700	0.40	0.32	0.08	0.25
82-08-29/30	1700 to 0500	0.36	0.25	0.11	0.44
82-08-30	0500 to 1700	0.13	0.13	0	0

continued...

Table 43. Concluded.

Date	Period	Total	Nylon	Teflon	Ratio Teflon/Nylon
82-08-30/31	1700 to 0500	0.08	0.08	0	0
82-08-31	0500 to 1700	0.05	0	0.05	0
82-08-31/09-01	1700 to 0500	0	0	0	0
82-09-01	0500 to 1700	0.04	0.04	0	0
82-09-01/02	1700 to 0500	0.11	0.11	0	0
82-09-02	0500 to 1700	0.10	0.08	0.02	0.25
82-09-02/03	1700 to 0500	0.13	0.06	0.07	1.17
82-09-03	0500 to 1700	0.28	0.26	0.02	0.08

9.8 PAN CONCENTRATIONS IN CALGARY, 1982

Pan concentrations in the atmosphere were measured periodically during 1982 at the University of Calgary.

Table 44. PAN measurements at the University of Calgary from March to August 1982.

Date	Time	ppb
82-03-13	1245	0.23
	1250	0.18
	1653	0.20
82-03-14	1105	0.18
	1120	0.18
	1335	0.20
	1210	0.18
82-03-15	0730	0.18
	0800	0.18
	0830	0.20
	0945	0.18
	1337	0.28
	1400	0.28
	1430	0.25
	1510	0.30
	1600	0.40
	1630	0.40
82-03-16	0817	0.40
	0830	0.38
	0900	0.45
	0935	0.45
	1004	0.23
	1042	0.33
	1100	0.40
	1130	0.35
	1200	0.33
	1300	0.28
	1400	0.30
	1505	0.28
	1535	0.20
	1630	0.23
82-03-17	0830	0.23
	0903	0.23
	1000	0.20
	1035	0.20
	1101	0.23
	1134	0.23
	1154	0.23
	1300	0.23
	1337	0.23
	1403	0.30
82-03-17	1429	0.25
	1500	0.30
	1540	0.30
	1558	0.33
	1629	0.33
82-03-18	0800	0.28
	0836	0.33
	0901	0.38
	0933	0.45
	0958	0.48
	1042	0.58
	1102	0.58
	1131	0.70
	1201	0.73
	1232	0.73
	1257	0.70
	1334	0.65
	1401	0.63
	1500	0.60
	1537	0.50
	1630	0.43
82-03-19	0730	0.35
	0800	0.38
	0901	0.40
	0932	0.43
	1007	0.48
	1028	0.48
	1058	0.50
	1132	0.48
	1153	0.53
	1319	1.08
	1330	1.10
	1345	0.95
	1359	0.55
	1433	0.43
	1500	0.28
	1533	0.30
	1602	0.38
	1629	0.28
82-03-21	1130	0.20
	1200	0.20
	1220	0.23
	1305	0.20

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-03-22	0730	0.20	82-03-24	1600	0.70
	0800	0.30		1618	0.63
	0830	0.23		1629	0.40
	0903	0.25		1653	0.60
	0935	0.25			
	0957	0.20	82-03-25	0730	0.25
	1030	0.25		0800	0.30
	1101	0.23		0826	0.35
	1130	0.23		0900	0.30
	1201	0.23		0930	0.30
	1231	0.20		1015	0.45
	1254	0.20		1032	0.75
	1334	0.18		1100	1.23
	1402	0.23		1130	0.93
	1430	0.15		1201	0.43
	1502	0.20		1230	0.43
	1600	0.15		1301	0.40
				1331	0.50
82-03-23	0803	0.15		1400	0.40
	0830	0.20		1430	0.35
	0857	0.20		1459	0.33
	0927	0.15		1533	0.35
	0954	0.18		1602	0.33
	1030	0.18		1629	0.43
	1055	0.20		1704	0.38
	1130	0.20		1745	0.35
	1155	0.18		1806	0.25
	1305	0.20			
	1337	0.20	82-03-26	0805	0.35
	1412	0.20		0826	0.30
	1437	0.23		0855	0.30
	1500	0.18		0938	0.40
	1600	0.20		1002	0.55
	1630	0.20		1040	1.20
				1100	0.85
82-03-24	0755	0.15		1129	0.45
	0830	0		1148	0.48
	0902	0.15		1401	0.43
	0932	0.15		1432	0.35
	0955	0.15		1459	0.40
	1100	0.18		1533	0.45
	1320	0.15		1605	0.50
	1332	0.20		1634	0.55
	1355	0.30		1700	0.55
	1500	0.30		1747	0.38

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-03-26	1815	0.38	82-04-01	1530	0.45
	1830	0.43		1600	0.58
	1700	0.40		1630	0.55
	1732	0.43			
			82-04-02	0830	0.40
82-03-28	0917	0.53		0900	0.58
	1000	0.50		0930	0.55
	1042	0.40		1000	0.70
	1128	0.28		1030	0.70
	1204	0.30		1100	0.68
	1302	0.23		1130	0.70
	1400	0.23		1230	0.63
	1509	0.20		1300	0.68
				1330	0.68
82-03-29	0720	0.15		1400	0.65
	0837	0.23		1430	0.60
	0937	0.18		1500	0.60
	1002	0.13		1530	0.75
	1100	0.15		1600	0.60
	1205	0.13		2030	0.33
	1405	0.15			
	1627	0.20	82-04-03	1300	0.30
82-03-31	1001	0.33	82-04-04	1010	0.30
	1112	0.33		1115	0.35
	1200	0.30			
	1259	0.40	82-04-05	0900	0.85
	1400	0.30		0930	0.90
	1510	0.25		1000	0.75
				1038	0.80
82-04-01	0730	0.33		1101	0.70
	0800	0.33		1130	0.73
	0830	0.35		1158	0.78
	0900	0.30		1300	0.65
	0930	0.38		1330	0.60
	1000	0.40		1400	0.60
	1030	0.38		1433	0.65
	1100	0.38		1500	0.55
	1130	0.45		1529	0.60
	1200	0.40		1600	0.55
	1230	0.45		1715	0.45
	1300	0.48			
	1330	0.53	82-04-07	0900	1.10
	1400	0.50		0931	1.25
	1500	0.53		1000	1.30

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-04-07	1030	1.33	82-04-14	1301	0.53
	1100	1.23		1316	0.37
	1130	1.25		1329	0.37
				1345	0.37
82-04-08	0810	0.41		1401	0.37
	0830	0.49		1416	0.37
	0908	0.53		1430	0.29
	0938	0.29		1445	0.37
	1003	0.45		1459	0.29
	1032	0.41		1515	0.37
	1102	0.45		1530	0.29
	1135	0.33		1559	0.37
	1202	0.41		1614	0.45
	1303	0.45		1622	0.37
	1330	0.41			
	1400	0.41	82-04-21	0826	0.29
	1430	0.53		0909	0.37
	1501	0.45		0931	0.37
	1545	0.33		1001	0.41
				1034	0.37
82-04-13	0800	0.37		1058	0.31
	0817	0.37		1133	0.33
	0830	0.69		1147	0.37
	0845	1.01		1234	0.27
	0901	1.33		1303	0.33
	0919	1.97		1334	0.33
	0945	0.69		1436	0.21
	1101	0.53			
	1129	0.85	82-04-22	0827	0.27
				0903	0.21
82-04-14	0844	0.53		0934	0.21
	0902	0.29		1008	0.57
	0916	0.37		1305	0.25
	0931	0.37		1335	0.27
	0946	0.37		1420	0.31
	0959	0.29		1440	0.33
	1016	0.29		1458	0.19
	1031	0.29			
	1045	0.37	82-04-23	0915	0.27
	1101	0.29		0957	0.25
	1115	0.37		1030	0.29
	1132	0.37		1100	0.35
	1148	0.29		1141	0.25
	1202	0.21		1200	0.41
	1247	0.29		1333	0.35

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-04-23	1402	0.37	82-04-29	0935	0.31
	1431	0.35		1005	0.27
	1500	0.37		1033	0.25
	1530	0.35		1055	0.23
	1557	0.29		1220	0.29
				1302	0.29
82-04-26	0730	0.29		1330	0.27
MST	0833	0.37		1400	0.27
	0904	0.43		1430	0.29
	0930	0.59		1456	0.29
	0951	0.39		1525	0.27
	1001	0.25			
	1107	0.41	82-05-31	0951	0.64
	1030	0.39		1029	1.48
	1100	0.39		1101	2.28
	1306	0.41		1129	1.24
	1315	0.41		1200	1.28
				1231	1.24
82-04-27	0901	0.39		1300	1.28
	0929	0.37		1329	1.60
	1002	0.31		1357	1.44
	1032	0.35		1429	1.36
	1203	0.37		1502	1.20
	1232	0.49		1534	1.16
	1304	0.23			
	1330	0.35	82-06-01	0745	1.16
	1430	0.39		0810	0.80
	1500	0.67		0828	0.88
				0904	1.16
82-04-28	0851	0.41		0931	1.32
	0931	0.41		1000	0.92
	1030	0.41		1030	1.08
	1101	0.53		1205	1.12
	1203	0.37		1245	1.24
	1231	0.37		1302	0.96
	1302	0.21		1335	0.92
	1330	0.35		1359	0.72
	1401	0.29		1501	0.80
	1434	0.29		1526	0.88
	1501	0.33			
			82-06-02	0736	1.04
82-04-29	0731	0.37		0801	1.12
	0801	0.35		0829	0.56
	0832	0.41		0859	0.56
	0901	0.45			

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-06-11	0706	0.23	82-06-14	0659	0.44
	0734	0.23		0730	0.36
	0804	0.26		0812	0.53
	0837	0.29		0827	0.59
	0855	0.47		0900	0.53
	0908	0.44		0932	0.62
	0930	0.87		0959	0.94
	0959	1.21		1030	0.87
	1028	1.26		1100	1.18
	1059	1.18		1131	0.96
	1130	1.43		1204	1.00
	1159	1.07		1234	1.13
	1220	2.53		1259	1.22
	1230	2.16		1329	1.30
	1259	2.38		1358	1.26
	1315	2.12		1435	1.05
	1327	2.34		1515	1.18
	1345	2.12		1531	0.79
	1358	2.34		1537	0.49
	1428	2.57			
	1444	2.59	82-06-15	0704	0.51
	1459	2.42		0727	0.53
	1515	1.67		0758	0.79
	1528	1.45		0828	0.92
	1545	1.65		0928	1.05
	1559	0.75		1002	1.35
	1614	0.49		1030	1.35
	1630	0.70		1059	0.75
	1736	1.26		1105	0.75
	1759	1.48		1127	1.26
	1816	1.78		1200	1.69
	1829	1.30		1227	1.65
	1846	1.52		1303	1.48
	1849	1.82		1330	1.99
	1915	1.35		1342	1.95
	1930	1.78		1359	2.04
	1946	2.08		1414	1.78
	2000	1.99		1428	1.86
	2015	1.65		1505	1.65
	2030	1.99		1515	1.95
	2045	1.82		1530	1.95
	2153	0.83		1544	1.84
	2200	0.79			
			82-07-09	1202	1.47
				1230	4.09
				1302	3.26

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-07-12	0800	0.32	82-07-14	1330	0.26
	0833	0.21		1403	0.32
	0932	0.32		1435	0.16
	1000	0.32		1500	0
	1030	0.53		1533	0
	1100	0.74			
	1200	0.84	82-07-15	0700	0.32
	1230	0.95		0739	0.58
	1259	0.63		0800	0.42
	1331	0.53		0830	0.42
	1401	0.68		0901	0.37
	1430	0.53		0936	0.26
	1501	0.68		1012	0.26
	1530	0.47		1057	0.21
				1305	0.26
82-07-13	0740	0.37		1359	0.26
	0810	0.95		1525	0.21
	0830	1.16			
	0900	1.16	82-07-16	0730	0.21
	0930	1.31		0802	0.21
	1000	1.63		0832	0.21
	1030	1.42		0900	0.21
	1100	2.52		0931	0.26
	1200	1.37		1150	0.42
	1300	1.68		1405	0.37
	1330	1.79		1507	0.32
	1400	1.26			
	1430	1.05	82-07-19	0734	0.10
	1500	1.26		0801	0.16
	1530	1.26		0830	0.21
	1600	1.05		0859	0.16
	1630	0.95		0930	0.26
	1700	0.74		1000	0.32
	1735	0.84		1030	0.32
				1100	0.37
82-07-14	0730	0.32		1203	0.21
	0903	0.32		1230	0.32
	0930	0.42		1300	0.21
	1003	0.58		1332	0.53
	1028	0.47		1438	0.21
	1101	0.37		1502	0.26
	1136	0.21			
	1205	0.21	82-07-21	0720	0.42
	1229	0.37		0827	0.37
	1304	0.26		0858	0.42

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-07-21	0934	0.58	82-07-26	0908	0.32
	0959	0.53		0937	0.42
	1028	0.58		1010	0.37
	1055	0.63		1044	0.42
	1215	0.63		1204	0.26
	1259	0.53		1325	0.63
	1327	0.63		1400	0.79
	1407	0.58		1434	0.79
	1500	0.47		1505	0.99
	1525	0.47			
			82-07-27	0706	0.58
82-07-22	0725	0.37		0740	0.63
	0804	0.32		0810	0.58
	0828	0.32		0838	0.63
	0903	0.32		0907	0.63
	0938	0.26		0936	0.63
	1002	0.26		1008	0.68
	1027	0.26		1038	0.89
	1059	0.32		1107	0.84
	1156	0.32		1200	0.84
	1230	0.32		1234	0.99
	1256	0.26		1302	0.95
	1327	0.37		1333	0.74
	1500	0.42		1403	0.74
	1525	0.37		1433	0.74
				1504	0.58
82-07-23	0728	0.32		1532	0.63
	0800	0.47			
	0835	0.58	82-07-28	0732	0.68
	0900	0.89		0805	0.63
	0930	0.74		0835	0.84
	1000	0.53		0907	1.26
	1035	0.42		0937	1.16
	1105	0.53		1013	1.26
	1200	0.63		1040	1.10
	1230	0.63		1110	1.68
	1300	0.68		1202	1.99
	1335	0.63		1232	2.57
	1400	0.51		1300	1.47
	1430	0.63		1328	2.05
	1500	0.58		1358	2.99
				1430	2.73
82-07-26	0712	0.21		1500	1.84
	0800	0.37		1530	1.58
	0835	0.32		1614	1.31
				1633	1.47

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-07-28	1700	1.16	83-08-03	1201	0.89
	1728	0.99		1229	0.95
				1259	0.42
82-07-29	0700	0.74		1334	0.21
	0730	0.84		1400	0.21
	0800	0.89		1429	0.26
	0827	0.84		1501	0.84
	0903	0.89		1528	0.74
	0927	1.05			
	1000	1.31	82-08-04	0730	0.79
	1031	1.37		0800	0.99
	1100	2.15		0830	0.79
	1130	2.16		0900	0.79
	1203	2.94		0935	0.84
	1230	3.09		0958	0.74
	1300	2.73		1030	0.58
	1330	2.78		1053	0.58
	1403	2.31		1205	0.58
	1429	2.10		1230	0.53
	1500	3.52		1259	0.51
	1528	2.63		1331	0.42
	1556	2.16		1402	0.68
	1627	1.37		1436	0.68
	1658	0.95		1459	0.84
				1529	0.79
82-07-30	0713	0.37			
	0758	0.51	82-08-05	0730	0.42
	0835	0.51		0806	0.58
	0910	0.53		0832	0.63
	0929	0.53		0905	0.74
	1003	0.53		0928	0.84
	1030	0.58		0958	0.89
	1053	0.58		1029	0.89
	1200	0.47		1059	0.99
	1230	0.74		1203	0.95
	1300	0.53		1232	0.84
				1300	1.05
83-08-03	0732	0.53		1330	0.79
	0800	0.53		1359	0.79
	0830	0.68		1431	0.99
	0859	0.74		1459	0.89
	0940	0.63		1529	0.79
	1005	0.84			
	1032	0.95	82-08-06	0730	0.74
	1058	0.84		0800	0.95

continued...

Table 44. Continued.

Date	Time	ppb	Date	Time	ppb
82-08-06	0830	0.63	82-08-10	1500	0.77
	0901	0.58		1531	0.57
	0928	0.68			
	1000	1.31	82-08-11	0732	0.62
	1030	0.99		0800	0.57
	1057	0.84		0830	0.51
	1203	1.05		0901	0.41
	1230	0.95		0934	0.46
	1304	0.84		1000	0.67
	1335	1.47		1103	1.85
	1408	0.84		1159	1.03
	1430	0.89		1433	0.31
				1457	0.31
82-08-09	0630	0.46		1528	0.82
	0700	0.67			
	0730	0.51	82-08-16	0730	0.26
	0804	0.57		0800	0.36
	0834	0.51		0934	0.82
	0911	0.36		1000	0.77
	0939	0.63		1028	0.98
	1004	0.63		1100	1.21
	1033	0.62		1131	1.57
	1102	0.82		1200	0.93
	1131	0.82		1230	1.10
	1200	0.77		1300	0.98
	1232	0.82		1333	0.46
	1300	0.62		1430	0.72
	1331	0.77		1500	0.57
	1405	0.77			
	1431	0.77	82-08-17	0800	0
	1501	0.67		0829	0
	1530	0.71		0853	0.26
				0931	0.36
82-08-10	0732	0.62		1002	1.00
	0833	0.87		1029	1.13
	0900	1.08		1130	0.77
	0930	0.72		1158	1.10
	1005	0.51		1233	0.93
	1032	0.72		1336	1.57
	1057	0.72		1400	1.95
	1207	0.41		1430	1.34
	1232	0.57		1500	0.93
	1259	0.51		1528	0
	1328	0.41			
	1400	0.87			

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Table 44. Concluded.

Date	Time	ppb	Date	Time	ppb
82-08-18	0804	0.46	82-08-24	1404	0.20
	0830	0.31		1500	0.26
	0912	0.72			
	1000	0.82	82-08-26	0735	0.15
	1034	0.93		0901	0.26
	1055	1.00		1215	0.15
	1205	0.67		1303	0.26
	1230	0.67		1403	0.20
	1329	0.62		1500	0.26
	1400	0.72			
	1433	0.72	82-08-27	0859	0.15
	1530	1.10		0945	0.15
				1100	0.26
82-08-19	0704	0.62		1200	0.31
	0732	0.51		1300	0.41
	0758	0.62			
	0904	0.51	82-08-30	0829	0
	1029	0.72		0859	0
	1059	0.72		1050	0.26
	1155	0.77		1328	0.36
	1258	0.67		1358	0.26
	1403	0.77		1433	0.51
	1432	0.77		1458	0.46
	1503	0.67		1527	0.46
	1528	0.46			
			82-08-31	0800	0.15
82-08-23	0730	0.31		0959	0
	0801	0.20		0931	0.20
	0832	0.31		1000	0.20
	0900	0.26		1030	0.20
	0935	0.20		1057	0.20
	1006	0			
	1100	0.20			
	1205	0.26			
	1233	0.26			
	1304	0.20			
	1330	0.31			
82-08-24	0728	0			
	0803	0			
	0858	0			
	1003	0.20			
	1030	0.20			
	1300	0.20			
	1337	0.20			